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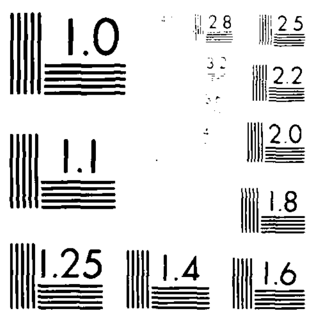
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AN ANALYSIS OF CAPACITY PLANNING
FOR DEPOT REPAIR OF AIRCRAFT COMPONENTS
USED ON FIGHTER AIRCRAFT ACQUIRED BY
AERONAUTICAL SYSTEMS DIVISION

John S. Rundle, Captain, USAF
Robert J. Myers, Captain, USAF

LSSR 42-83

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While considerable emphasis has been placed on industry's ability to produce end items, little emphasis has been given to the long-range planning aspects of that support to the weapon system provided by repair capacity from both Government and industry sources. To study this problem, nine SPO planning elements and their defense industry counterparts, representing three ASD managed fighter aircraft weapon systems, were sampled. This sample provided information used to test seven hypotheses: a) four related to the factors that are given consideration when planning repair capacity; b) two related to differences in repair capacity planning when the source of the capacity changes; and c) one related to differences between Government and industry repair capacity planning. The overall conclusion was that a clear and standardized definition of the goals and means of accomplishing repair capacity planning is not available. DoD management action to provide this definition is recommended. Further, immediate management action to collect lessons learned from experienced Government and industry repair capacity planners, and the integration of these lessons learned in a guide for planning elements, is recommended.

LSSR 42-83

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FOR DEPOT REPAIR OF AIRCRAFT COMPONENTS

USED ON FIGHTER AIRCRAFT ACQUIRED BY

AERONAUTICAL SYSTEMS DIVISION

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirement for the

Degree of Master of Science in Logistics Management

By

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September 1983

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This thesis, written by

Captain John S. Rundle

and

Captain Robert J. Myers

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT

DATE: 28 September 1983

Lyle W. Lockwood
COMMITTEE CHAIRMAN

Ronald D. [illegible]
READER

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CHAPTER 1

INTRODUCTION

Background

Consider the story of Sampson the Danite. After being delivered up to the Philistines, "he found a new jawbone of an ass, and put forth his hand, and took it, and slew a thousand men therewith [Judges 15:15]." At first glance, this story might seem to describe the ideal weapon system: low cost, no acquisition lead time, operationally effective. However, imagine how easily things could have taken a turn for the worse if the weapon had failed.

While Sampson, who had a "use once and throw away" weapon system, didn't have to plan for the possibility of a broken jawbone in B.C. 1140, today's warriors are not equally blessed. Modern weapon systems have progressed beyond the disposable stage and the need to repair these systems is recognized as an important part of the overall acquisition process. This thesis deals with planning for the repair that is concomitant with current weapon system acquisition (see Glossary for definitions).

The remainder of this chapter reviews the process by which weapon systems are acquired. Following a general acquisition process review, the incorporation of logistic support into the acquisition process is described. A general model of the repair process implemented by DoD to repair weapon systems is introduced. The resulting area that is the focus of this research is then stated. Following this general problem statement, a more focused look at DoD policy that forms the framework for weapon system maintenance is reviewed. Then the general process by which productive capacity is planned is presented. This chapter then culminates in the research objectives of this study and the resulting research hypotheses to be tested.

DoD Acquisition Process

To begin to understand repair, the main subject of this study, the overall DoD weapon system acquisition process should be understood. To provide this understanding, the following review of the weapon system acquisition process first discusses general DoD acquisition policy, then describes the process in terms of mission analysis and the four phases of the acquisition process.

Two key policy documents for the acquisition of new

weapon systems are Department of Defense (DoD) Directive 5000.1 "Major System Acquisitions" and DoD Instruction 5000.2 "Major System Acquisition Procedures". One of the main thrusts of these two documents is that the acquisition of a new weapon system should be carried out efficiently and effectively to achieve the operational objectives of the United States armed forces in their support of national policies and objectives (17:1). The DoD policy for acquisition management covers seven major areas. System design and price should be competed as much as possible to ensure cost effectiveness and responsiveness to mission needs. The acquisition process should emphasize improved readiness and sustainability. The programs should be as stable as possible with respect to planning, technological evolution, adequate funding, rates of production, and program structure. Responsibility and accountability should be clearly established. Cost effectiveness should be balanced with mission goals. Defense acquisition projects should cooperate with allies to achieve the highest degree of interoperability of equipment and to avoid duplication of effort. Lastly, the acquisition process should strive to support a strong industrial base which promotes a strong defense (17:2-3).

The DoD organizational components, Office of the Secretary of Defense (OSD), and Office of the Joint Chiefs of

Staff (OJCS) are all involved in continuing analysis of their respective mission areas. The object of the constant mission analysis is to determine if there are more effective means of performing the tasks or if there are deficiencies. The acquisition of a new system may be the result of a deficiency that is discovered during the analysis process, the discovery of a new technology that can perform the task better, a decision to develop a new capability, or an opportunity to reduce DoD cost of ownership. Generally, the DoD using commands identify these new requirement analyses in the Statement of Operational Need (SON) document. However, a new system may not be acquired until an assessment of existing systems and doctrine has been made (17:4).

If the need for a new weapon system is revealed during the analysis process, the weapon system concept may enter the acquisition process. The weapon system acquisition process translates the mission need into military hardware. There are four defined phases in the acquisition process: concept exploration, demonstration and validation, full scale development, production and deployment. The mission need determination is submitted as part of the component service's Justification of Major System New Starts (JMSNS) along with its Program Objectives Memorandum (POM) during the annual defense budget planning cycle. Each component

service provides its own JMSNS and POM as part of the Planning Programming and Budgeting System (17:4).

When the OSD issues program guidance in the form of a Program Decision Memorandum (PDM) to the component submitting the JMSNS, the military service is authorized to start the program when funds are available. Normally, the OSD will indicate in the PDM whether or not a new system is to be managed as a major system (17:4).

As the weapon system progresses through the acquisition process, the transition from one phase to the next is planned, reviewed, and coordinated with OSD, the Defense Acquisition Review Council (DSARC), the military departments, OJCS, and the defense agencies. The concept exploration phase is the portion of the process when a wide range of possible solutions to meet the mission need are considered. The study will include analysis of design concepts, expected operational capabilities, industrial base capacity, cost estimates, and support requirements. When the study is completed the DSARC members submit a System Concept Paper (SCP) to the OSD. The SCP summarizes the results of the exploration phase and it identifies concepts to be carried into the next phase - demonstration and validation. This approval for the project to continue is contained in a

document called a Secretary of Defense Decision Memorandum (SDDM). During the demonstration and validation phase, the remaining concepts are studied in further detail with respect to cost, schedule, producibility, performance, industrial base responsiveness, and testing to reduce risk before the commitment of major resources toward full scale development. A Decision Coordinating Paper (DCP) and Integrated Program Summary (IPS) are prepared during this phase to provide information to the DSARC. The DSARC will make its recommendation to the OSD; then after DSARC results are review by the OSD, another SDDM must be issued for the program to continue into Full Scale Development (FSD). During FSD the best concept from the prototype systems has been selected for further study with respect to producibility and supportability. The DCP and IPS are updated to summarize the component's acquisition planning for the system's life cycle. The reports also provide a management overview of the program. The decision to begin production and deployment is then made by the OSD or the service component Secretary, depending on the designated management level of the program (17:8). DoD Directive 5000.1 and DoD Instruction 5000.2 are policy directives that are derived from the Office of Management and Budget (OMB) Circular A-109 "Major System Acquisitions". OMB Circular A-109 is a prime national

document for weapon system acquisition (11:145). Inherent in this acquisition process is the implementation of national policy that the federal government will rely upon the private sector to supply goods and services to meet national objectives (20). Figure 1.1 shows the OMB Circular A-109 acquisition model.

Logistic Support and Productive Capacity

Weapon system component repair planning results from, and is a link between, the areas of logistic support planning and productive capacity planning (3). Therefore, the following discussion focuses on a) the aspects of logistic support that affect repair planning, b) the aspects of productive capacity that affect repair capacity planning, c) the management of repair capacity and the impacts of this management on the acquisition process, and d) the organizational structure that exists in the Air Force to provide repair capacity planning and management.

As one of the two major areas linked by and affecting repair planning and management, logistic support is emphasized early in the acquisition process. During the acquisition process, the logistic considerations of readiness, sustainability, and economy of manpower are addressed in the SCP and DCP documents. Within these documents, opera-

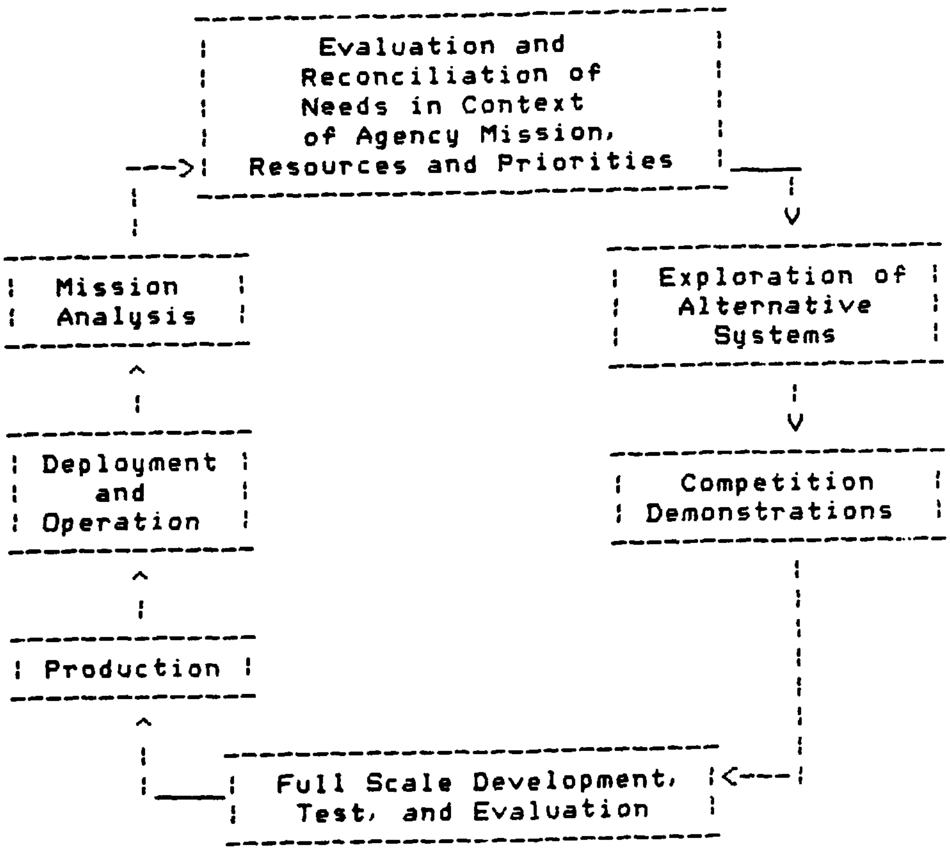


FIGURE 1.1

OMB Circular A-109 Model

tional readiness and supportability planning sections include estimates for field reliability, maintainability, operational availability, and resupply time. Additional logistic considerations are contained in the IPS. Within this document, plans for providing interim and long term contractor support, resupply time, analysis of contractor versus in-house support, and the provision of post production support to meet system readiness goals throughout the operational life of the system are detailed (18:Enclosure 5-2). Also included are estimates for initial spares and repair parts (18:IPS-3A-10).

Within the area of logistic support, Integrated Logistic Support (ILS) planning also impacts repair planning and management. DoD Directive 4100.35 "Development of Integrated Logistic Support for Systems/Equipments" is a top level document that directs ILS planning during the acquisition process. The joint service guide to implement logistic support planning has the Air Force designation, Air Force Pamphlet (AFP) 800-7 "Integrated Logistics Support Implementation Guide for DoD Systems and Equipments". The maintenance management matrix provided in AFP 800-7 reveals how logistic planning is integrated with the stages of development of the acquisition process (13:X-29). The AFP 800-7 management matrix indicates that facilities and maintenance planning

are two of the elements that comprise a definition of logistic support requirements. Actual planning for plant and equipment begins during the concept exploration phase of the acquisition process (13:X-29). This initial planning for maintenance is the foundation for supplying the support for the deployed system.

Coupled with logistic support, is the second major area linked by and affecting repair planning and management, productive capacity planning and management. Productive capacity to meet the demands generated when a weapon system enters the operational inventory is made up from the ability of the industrial resources of both the government and the private sector to produce end items, spare parts, and repair damaged items (8). Planning to establish a productive capacity to support the deployment and operation of a new weapon system includes consideration of many factors. Some of these factors are a) the maturity of the manufacturing technology involved in the new project, b) any constraints with respect to critical materials, c) manufacturing efficiency, and d) considerations for providing a surge capability.

Two major policy documents influence productive capacity and its subset, repair capacity. First, OMB Circular A-109 provides a framework and a process that yields del-

ineation of the actions to be taken by both government and industry in the development, production, and support of systems necessary to meet national needs. The second policy document, OMB Circular A-76 "Policies for Acquiring Commercial or Industrial Products and Services Needed by the Government" indicates that it is national policy to depend upon the private sector of the economy to provide the goods and services needed to meet national objectives (20). Exceptions to this policy are made in cases where the needs of national security dictate. An example of one of these exceptions is the government's establishment of an in-house (organic) capability to conduct repair in support of weapon systems. Thus, repair capacity planning is a component of the total weapon system acquisition planning process and encompasses planning to establish repair capability and capacity to support the operational system by contract with the private sector, conduct of repair by government owned and operated facilities, or both (8).

Along with conforming to the policies of OMB Circulars A-109 and A-76, military acquisition managers have the additional responsibilities of providing military effectiveness and readiness and being efficient with public funds when a new weapon system is acquired. Due to both the high cost of defense and limits on the defense budget, each dollar spent

should efficiently provide military effectiveness consistent with national objectives. Repair of weapon system components can be an efficient means of providing military effectiveness and readiness. However, since repair of weapon system components is planned for accomplishment in both government and private sector facilities there is a significant challenge to efficiently plan for and manage repair capability and capacity to provide support of military effectiveness and readiness objectives (8).

Insufficient capacity for timely repair of weapon system components reduces readiness by delaying the return to the operational units of those components that have failed, been damaged, or have worn out. An alternative to providing sufficient repair capacity would be to increase spares inventory levels to accommodate the repair delays. This action would increase demands on the already large and strained defense budget. Providing repair capacity in government or contractor facilities, or both, that exceeds both peacetime and contingency demand levels is an inefficient expenditure since this excess capacity would be unused (8).

The focus of this study is the nexus of the process between government and industry acquisition and logistics

personnel as they plan for and establish capacity for repair of weapon system components by either private industry (under government contract), U. S. military depots, or both. To understand this relationship between the government and industry, Figure 1.2 depicts a simplified organizational structure for system acquisition and support management (8).

Within the system acquisition organizational structure, responsibility flows down from DoD through Headquarters USAF to Air Force Systems Command (AFSC). This level has the responsibility for assigning weapon system acquisition management to one of its product divisions such as Aeronautical Systems Division (ASD). At the product division level a System Program Office (SPO) is established and given the responsibility to manage research and development and production of the weapon system. The SPO acts as the focal point between the Air Force and the defense contractors that are producing the weapon system.

Within the support management organizational structure, responsibility again flows down from DoD through Headquarters USAF, in this case to Air Force Logistics Command (AFLC). This level has the responsibility for assigning weapon system support management to one or more of its Air Logistic Centers (ALCs). At the ALC level, a System Manager

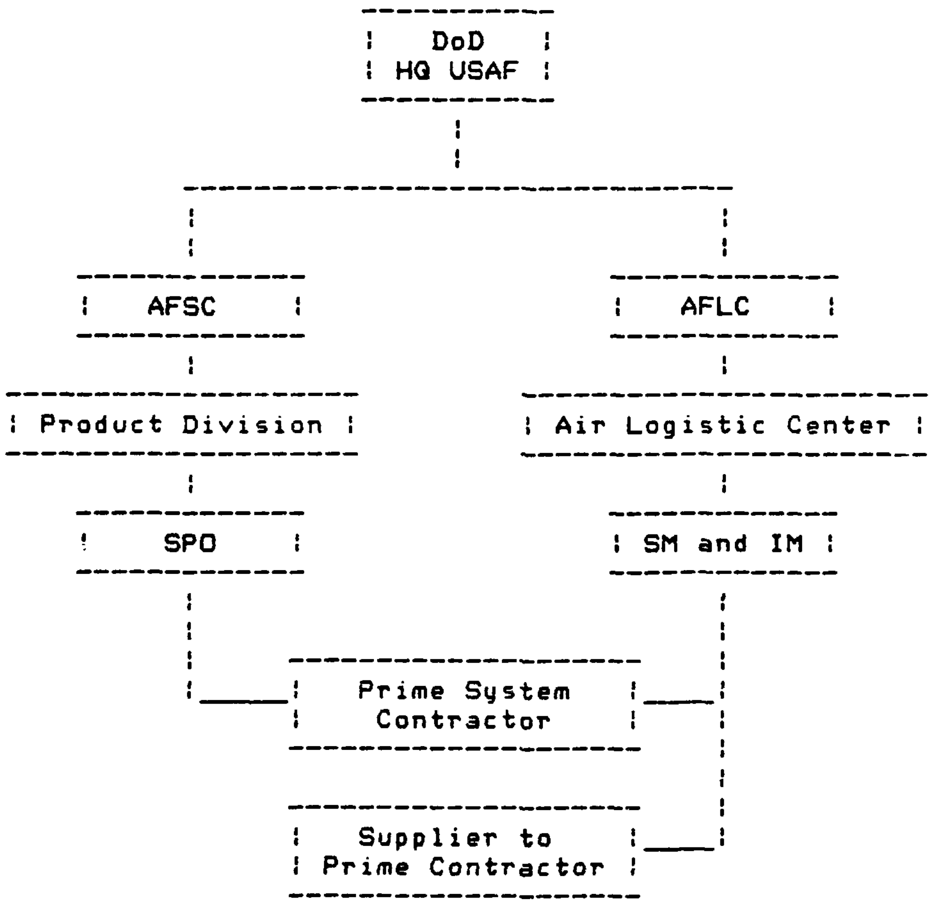


FIGURE 1.2

Acquisition and Support Structure

(SM) is assigned and given overall logistic support management responsibility for the weapon system. Also at the ALC level, a number of Item Managers (IMs) are assigned and given responsibility for specific components of the weapon system. Both the SM and the IMs interact with other Air Force activities and defense contractors.

Repair Process

To fully understand the process government and industry acquisition and logistics personnel use when planning repair capacity, the structure of the repair system should be understood. As a means of describing this repair process three phases within the life cycle of the weapon system component can be identified. The first phase involves the production of the weapon system and its delivery to the operational inventory. The second phase involves the operational use of the weapon system and the eventual generation of a reparable item. The third phase involves the return of the reparable item to a depot level maintenance activity and the subsequent actions that must be accomplished to return the item to the operational inventory. These three phases are graphically displayed in Figure 1.3.

The flow of the first phase of the repair process begins with the production of the weapon system component by

```
 Subsystem Production          Subsystem Production
   and Integration              by Prime Contractor's
  by Prime Contractor        Supplier or Subcontractor
          |                              |
          V                              V
 Integration and Test <------- Integration and Test
          |
          |                                         *************
          V                                         * PHASE ONE *
Acceptance and  Delivery                            *************
----------|-------------------------------------------------------
          V
Operational Utilization
Resulting in Generation
  of Reparable Items
          |
          V                                         *************
 Organizational Level                               * PHASE TWO *
     Maintenance                                    *************
   (LRU Isolation)
          |
          V
  Intermediate Level
     Maintenance
   (SRU Isolation)
----------|-------------------------------------------------------
          V
   Cognizant ALC's
   Item Manager or ------------------> Organic Depot
   System Manager  ----------                |
          |                |                 |
          V                V                 |
   Prime Contractor     Supplier             |
          |                |                 |
          V                V                 V
          -----------------------------------
                           |
                           V
                    Fault Isolation
                           |
                           V                        ***************
                    Repair and Test                 * PHASE THREE *
                           |                        ***************
                           V
                       Return to
                 Operational Inventory
```

FIGURE 1.3

The Repair Process

the contractor. This contractor may be either a prime contractor or a prime contractor's supplier or subcontractor. This production effort requires the use of special test equipment for integration and test. While a supplier or subcontractor will perform integration and test for weapon system component acceptability, the prime contractor will perform not only integration and test of components produced in-house, but will also perform integration and test of end items to be presented to the government for their acceptance into the operational inventory. Following delivery of the weapon system or any components delivered as spares, the operational units will generate reparable items. These reparable items will first be identified and removed from the weapon system by organizational level maintenance activities. The majority of these reparable items will be in the form of line replaceable units (LRUs). Once an LRU has been identified as requiring repair, the intermediate level maintenance activity at the operational site is tasked with isolating the problem to the shop replaceable unit (SRU) level. At this point the cognizant Air Logistic Center (ALC) Item Manager (IM) is notified of the existence of the item needing depot level repair.

Once the IM has been notified that a reparable has been generated, instructions are provided to ship the reparable

item to a depot level repair activity. This depot level repair activity may be either the prime contractor, the prime contractor's supplier, or an organic depot. Regardless of the depot level repair activity to which the reparable item is shipped, the item will be subjected to a series of fault isolation, repair, and test steps which will eventually result in the repaired item being returned to the operational inventory.

Problem Statement

The acquisition and support of new weapon systems continues to be one of the important uses of our nation's resources. The Executive Office of the President, OMB, and the Office of Federal Procurement Policy have recently developed a proposal to make all Government procurement conform to a uniform acquisition process. One of the basic reasons this proposal was made was that "there is no Government-wide requirement for long-range procurement planning [5:19]," and that "such planning is often inconsistent, inadequate or lacking altogether [5:20]." A major portion of the effort expended in the acquisition process is the analysis and planning for the logistic support of the system. One aspect of the logistic support planning effort is to plan the long range productive capacity necessary to meet

projected demands over the life cycle of the system. While considerable emphasis has been placed on industry's ability to produce end items, little emphasis has been given to the long-range planning aspects of that support to the weapon system provided by repair capacity from both Government and industry sources.

Policy Review

In the Department of Defense, immediate emphasis is placed on Integrated Logistic Support when a weapon system enters the acquisition process, and the emphasis continues through all phases of the acquisition process. Equipment maintenance is an important element of ILS because it is "essential to the rapid and sustained application of military power [14:1]." As a result, numerous DoD Directives and Instructions have been published to establish the broad objectives, policy, and responsibilities of DoD Components, particularly the military departments, toward the management of DoD equipment maintenance. These documents have resulted in a general model of the equipment maintenance management process to be implemented by all DoD components.

Many basic objectives and policies regarding equipment maintenance, and its subset, repair, are set forth in DoD

Directive 4151.16 "DoD Equipment Maintenance Program". In this document, maintenance engineering and maintenance production are identified as the two main subfunctions of equipment maintenance. Maintenance engineering is defined as:

> That activity of equipment maintenance which develops concepts, criteria and technical requirements during the conceptual and acquisition phases to be applied and maintained in a current status during the operational phase to assure timely, adequate and economic maintenance support of weapons and equipments [16:1].

These activities of a) concept of maintenance planning, b) maintenance demand forecasting, and c) resource requirements planning are achieved as an important part of the overall ILS program that is to begin at the start of the conceptual phase of the acquisition process (19:2). Responsibility for the accomplishment of ILS, and, thus, equipment maintenance engineering activities, is assigned to the program manager who is "supported by a qualified ILS manager ... to serve as the program focal point [19:4]."

The second main subfunction of equipment maintenance is maintenance production and its associated management function. Maintenance production management is the process of: "planning, organizing, staffing, directing, and controlling organic industrial resources engaged in the physical performance of equipment maintenance [16:1]." Maintenance produc-

tion management can be further subdivided into the three distinct areas of maintenance support, direct maintenance support, and indirect maintenance support.

The first area of maintenance production management, maintenance support, involves translating the maintenance demand forecasts, resource requirements, and maintenance concepts developed by maintenance engineering into the plans and programs for actual production maintenance. The second area of maintenance production is direct maintenance support. This function involves organizational and intermediate level maintenance "performed on material while it remains in the custody of the using military command [14:Enclosure 2]." The final subdivision of maintenance production management, indirect maintenance support, involves depot level maintenance " performed on material after its withdrawal from the custody of the using military command [14:Enclosure 2]."

The planning and acquisition of depot level (indirect maintenance) support for new weapon systems generally considers contract maintenance phasing toward full organic maintenance. During the FSD phase of the acquisition process, planning is accomplished that results in:

> Explicit and visible plans, resources, and contract requirements for: ... development of ILS elements. including a maintenance plan, on a schedule commensurate with contractor / government support transi-

tion objectives [19:Enclosure 3].

This " transition from contractor to government support (if any) shall allow a phased build up of organic support capability for each subsystem at each maintenance level [19:4]." Regardless of who (contractor or government) supplies depot level support, the maintenance capability of the depot should be commensurate with the demand for repair that will be generated (15:2).

Capacity Planning

The availability of productive capacity is a key to the ability to meet the requirements of demand experienced by any industry producing goods or services. Productive capacity determines the "maximum output rate for products or services [4:195]." Thus, it can be seen that the planning function associated with productive capacity is an important element within the control of management.

A review of the tasks associated with capacity planning includes four processes (4:197). These four steps are : a) determination of expected demand to be experienced, b) determination of alternative means of meeting these demands on productive capacity, c) evaluation of the alternatives, and d) the selection and implementation of a plan to achieve the capacity needed to meet demand.

The first general area to be considered in planning capacity is the determination of expected demand to be placed on the productive capacity. During this stage of the capacity planning process, a predicted demand is generated. Next, the existing capacity is evaluated to determine how much of the predicted demand can be met by currently available productive capacity. Finally, the net capacity increase needed to satisfy future demand is determined.

"The accurate and timely prediction of demand requirements provides an essential input for managerial decision making [2:1]." This input is especially important for productive capacity planning decisions. Probably the most widely used means of providing this input is by the technique of forecasting.

A review of available forecasting techniques reveals a wide variety of methods. Two major categories can be identified, qualitative forecasting techniques and quantitative techniques. Within the qualitative category are such techniques as the Delphi method and market research. These qualitative forecasting techniques are generaly used only when little or no quantitative data is available.

When a reasonable amount of quantitative data is available, the quantitative forecasting techniques are a more

important means of determining demand. Three categories of quantitative techniques can be identified (2:9). These are: a) time series techniques, used to predict future occurrences based on historical data, b) causal techniques, which include regression and econometric modeling, and c) multi-model techniques, which are based primarily on computer simulation.

Once a forecast of expected demand has been made, the existing productive capacity is evaluated to determine how much of the expected demand can currently be met. This determination includes an evaluation of equipment and personnel resources (6:200). Finally, once demand has been predicted and available capacity measured, the net capacity increase needed to meet demand can be determined. When this determination has been made, the next step of the planning process can be undertaken - the identification of alternatives.

Identification of alternatives involves consideration of the resources that constitute capacity: plant, equipment, tools, materials, and labor. In addition, lead time is an important consideration since "the lead time for acquiring capacity can vary depending on the kind of capacity required [12:202]." Once these alternatives have been identified,

evaluation of the alternatives can be made, and an alternative to be implemented can be selected.

The relationship of weapon system acquisition to capacity planning results from the requirement to produce goods and the need to support those produced systems when they are placed in the operational inventory. Of the four major steps in the capacity planning process, the first two - determining expected demand and determining available capacity - are participated in, to a great extent, by government planning elements and associated industry planning elements.

Because demand for productive capacity is generated by the acquisition and deployment of a weapon system, the Air Force and its associated aerospace contractors should be concerned with demand forecasting. Several sources of demand can be identified during the acquisition and deployment of an Air Force weapon system. The first, and most readily apparent, source of demand is for the end item system that is to be placed into the operational inventory. These end item systems are supported by the second source of demand, spares. This demand is composed of a number of sources: a) initial spares, to support the early deployment to the field, b) follow-on spares, to support long term deployment, c) War Readiness Material, d) Foreign Military Sales, and e)

training (9:11-22). A third source is equipment modifications resulting from engineering design changes. A fourth source of demand, also generated to support the end item systems, is repair requirements.

In addition to the involvement of Air Force and aerospace contractor capacity planning elements in the area of requirements determination, the area of determining capacity to meet demand receives heavy consideration. This results from the way in which capacity is acquired. Generally, the same contractor that uses productive capacity to produce end item systems is required to produce spares and provide for repair. In order to meet the demand for repair capacity, the aerospace contractor, in concert with Air Force elements, should decide on the division of repair and production processes. This division can be made in one of three ways:

> (1) repair is accomplished simultaneously with production; that is, repair and production actions take place on the same line intermittently, (2) repair and production activities take place on the same line during different, distinct time shifts, or (3) repair and production activities are conducted on several different, physically separated lines [9:23].

Because of the various possible divisions of repair and production, capacity planning elements should consider this factor when determining total productive capacity.

As a conclusion to this discussion of capacity planning, the relationship between repair of DoD weapon systems and planning for the capacity to provide this repair is described by Table 1.1 and Figure 1.4. Table 1.1 compares three aspects of repair capacity planning: a) the planning activities involved, b) the determinants of repair capacity, and c) the ways in which repair capacity is utilized. Figure 1.4 graphically displays the weapon system life cycle and how the accompanying repair requirements generated during this life cycle are met by both contractor supplied repair resources in the form of special test equipment and by government supplied repair resources in the form of organic depot level support equipment. Within this figure, three distinct periods are identified. These periods are derived from the source of repair and are distinguished as follows:

(1) Period one is defined as that period in time when depot level repair is provided exclusively by contractor special test equipment.

(2) Period two is defined as that period in time when depot level repair is provided by both contractor special test equipment and organic depot level support equipment.

TABLE 1.1

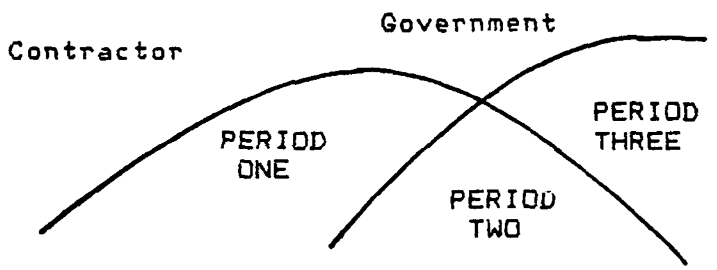
Aspects of Repair Capacity Planning

CAPACITY

Planning	Determinants	Utilization
*Requirement forecasting	*Fixed Resources Plant Equipment Tools and test equipment	*Production end items
*Alternative identification		*Spares Initial Follow-on WRM
*Alternative evaluation	*Variable Resources Materials Labor	*Repair
*Alternative selection and implementation	*Lead time	*Modifications

WEAPON SYSTEM LIFE CYCLE

CONCEPT EXPLORATION	DEMON-STRATION & VALIDATION	FULL SCALE DEVELOPMENT	PRODUCTION & DEPLOYMENT



REPAIR CAPACITY

FIGURE 1.4

Weapon System Life Cycle and Repair

(3) Period three is defined as that period in time when depot level repair is provided exclusively by organic depot level support equipment.

Research Objectives

The overall objective of this study is to analyze repair capacity planning relationships between Air Force System Program Offices (SPOs) and aerospace contractors. Specific objectives are as follows:

Research Objective 1

Determine if the factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair capacity were considered important factors by SPO planning elements when they were planning repair capacity.

Research Objective 2

Determine if these same factors were considered important by contractor planning elements when they were planning

repair capacity.

Research Objective 3

Determine if other factors were considered important by SPO planning elements when they were planning repair capacity.

Research Objective 4

Determine if other factors were considered important by contractor planning elements when they were planning repair capacity.

Research Objective 5

Identify differences in repair capacity planning as performed by SPO planning elements and contractor planning elements.

Research Objective 6

Identify differences in repair capacity planning as performed by SPO planning elements during the three distinct periods characterized by the source of depot level repair capacity.

Research Objective 7

Identify differences in repair capacity planning as performed by contractor planning elements during these same periods.

Research Hypotheses

Major Hypothesis 1

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity.

Subhypothesis 1A

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be

provided exclusively by contractor special test equipment.

Subhypothesis 1B

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 1C

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Major Hypothesis 2

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity.

Subhypothesis 2A

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 2B

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the divi-

sion of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 2C

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Major Hypothesis 3

Other factors were considered important by SPO planning elements when they were planning repair capacity.

Subhypothesis 3A

Other factors were considered important by SPO planning

elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 3B

Other factors were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 3C

Other factors were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Major Hypothesis 4

Other factors were considered important by contractor planning elements when they were planning repair capacity.

Subhypothesis 4A

Other factors were considered important by contractor planning elements when they were planning repair capacity

for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 4B

Other factors were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 4C

Other factors were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Major Hypothesis 5

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the contractor elements.

Subhypothesis 5A

There is a significant difference between the repair capacity planning factors considered important by the SPO

planning elements and the factors considered important by the contractor planning elements when planning for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 5B

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the factors considered important by the contractor planning elements when planning for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 5C

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the factors considered important by the contractor planning elements when planning for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Major Hypothesis 6

There is a significant difference between the repair

capacity planning factors considered important by the SPO planning elements whether planning for depot level repair to be provided exclusively by contractor special test equipment, planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment, or planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 6A

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 6B

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided

exclusively by organic depot level support equipment.

Subhypothesis 6C

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

Major Hypothesis 7

There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements whether planning for depot level repair to be provided exclusively by contractor special test equipment, or planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment, or planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 7A

There is a significant difference between the repair

capacity planning factors considered important by the contractor planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 7B

There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 7C

There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

CHAPTER 2

RESEARCH METHODOLOGY

Introduction

The previous chapter described the background of the current policy and objectives regarding equipment maintenance of DoD material. Capacity planning to meet the demands generated by repair requirements as related to overall production capacity was also discussed. In addition, the objectives and the research hypotheses of this thesis were addressed.

This chapter describes the research methodology to be used in this study. The chapter explains the methodology by means of an examination of the following areas:

(1) populations of interest,

(2) sample selection,

(3) data collection,

(4) data analysis,

(5) hypothesis testing,

(6) assumptions, and

(7) limitations.

Populations of Interest

Since capacity planning is an important part of the acquisition and logistic support processes, the universe for the research consists of all currently active DoD weapon system acquisition programs. While many populations can be identified within this universe, Figure 2.1 illustrates the populations of interest for this research.

Population I consists of the capacity planning elements of aircraft SPOs of the Aeronautical Systems Division (ASD) of Air Force Systems Command (AFSC), located at Wright-Patterson AFB, Ohio. Population II consists of the capacity planning elements of the aerospace contractors producing the aircraft.

Sample Selection

A sample of eighteen capacity planning elements related to three ASD managed aircraft programs will be selected. Nine of the capacity planning elements will be selected from Population I, the ASD aircraft SPOs. Paired with each SPO capacity planning element will be its respective contractor capacity planning element from Population II.

This study selected three ASD fighter aircraft programs on a purposive basis to allow three homogeneous clusters

```
                         DoD
                          |
     ----------------------------------------------
     |              |              |              |
   ARMY         AIR FORCE         NAVY          OTHER
                    |
     ----------------------------------------------
     |                     |                      |
   AFLC                  AFSC                   OTHER
                           |
     ----------------------------------------------
     |          |          |          |           |
    ESD         AD        ASD        BMO        OTHER
                           |
     ----------------------------------------------
     |                     |                      |
  Bombers              Fighters                 Other
                           |
     ----------------------------------------------
     |          |          |          |           |
************************************    F-5      Other
* F-16       F-15       A-10 *
*____________________________*
*       Population I         *
******************************


                   DEFENSE INDUSTRY
                          |
     ----------------------------------------------
     |                    |                       |
  Missiles             Aircraft                 Other
                          |
     ----------------------------------------------
     |                    |                       |
  Bombers              Fighters                 Other
                          |
     ----------------------------------------------
     |          |         |          |            |
******************************     F-5       Other
* F-16       F-15       A-10 *
*____________________________*
*       Population II        *
******************************
```

FIGURE 2.1

Population Structure of Universe

that were internally heterogeneous with respect to subsystem selection, which is described below. This study focuses on fighter aircraft because these acquisitions represent products that: a) are purchased in large numbers, b) consume a large amount of total DoD resources, and c) are uniquely military in nature.

Within each aircraft program, the major subsystems were identified and placed into one of three categories: electrical, mechanical, or hydraulic. Three subsystems from each aircraft program, one from each of the three categories, were selected. This selection was made using a quota type purposive process.

Data Collection

This section includes a description of pertinent population parameters, the techniques used to collect data on these parameters, and validation of the techniques.

Seven parameters of each population were studied:

(1) The relative importance of repair demand forecasting as part of repair capacity planning.

(2) The relative importance of having an in-house capability to generate repair demand forecasts.

(3) The relative importance of estimating repair resource capacity relative to repair capacity planning.

(4) The relative importance of having an in-house capability to estimate repair resource capacity.

(5) The relative importance of the division of repair and production resources relative to repair capacity planning.

(6) The relative importance of the disposition of contractor repair resources relative to repair capacity planning.

(7) Other factors that were important when planning repair capacity.

The interview technique was used as the means for collecting data. Interview guides were used to obtain the responses sought. The interview guides for this data collection, furnished in Appendix A, were used to interview all personnel.

The interview guides included questions requiring open ended responses and structured responses. For the questions requiring structured responses, an ordinal scale was used. This scale, while of a continuous nature, allowed the

respondent to select one of five possible choices: no importance, little importance, acceptable amount, significant importance, and great importance. These choices were assigned values on an ordinal scale from one to five, with no importance being assigned a value of one and great importance being assigned a value of five. In addition, the choice of no opinion was added and assigned a value of zero. The selection of this scale permitted nonparametric statistical analysis based on the assumption that a meaningful difference between the possible choices exists (7:261-265).

Interview Guide A was used to collect data that represented the period when it was planned to have contractor special test equipment provide depot level repair (period one). Interview Guide A was used as the means of obtaining data from SPO and contractor planning elements with respect to the seven parameters to be studied, as well as additional information that was useful in understanding other aspects of the repair capacity planning process. Both the SPO planning elements selected from Population I and the contractor planning elements selected from Population II were interviewed using this guide.

Interview Guide B was used to collect data that represented the period when it was planned to have both con-

tractor special test equipment and organic depot level support equipment provide depot level repair (period two). Interview Guide B was used as the means of obtaining data from SPO and contractor planning elements with respect to the seven parameters to be studied, as well as additional information that was useful in understanding other aspects of the repair capacity planning process. Both the SPO planning elements selected from Population I and the contractor planning elements selected from Population II were interviewed using this guide.

Interview Guide C was used to collect data that represented the period when it was planned to have organic depot level support equipment provide depot level repair (period three). Interview Guide C was used as the means of obtaining data from SPO and contractor planning elements with respect to the seven parameters to be studied, as well as additional information that was useful in understanding other aspects of the repair capacity planning process. Both the SPO planning elements selected from Population I and the contractor planning elements selected from Population II were interviewed using this schedule.

Table 2.1 shows the relationship between the Interview Guides, the planning elements, the Research Objectives, and

TABLE 2.1

Relationships Within Study

Planning Period	Planning Element	Research Hypotheses 1	2	3	4	5	6	7
1	SPO	Given Factors *1						
1	Contractor		Given Factors *2					
1	SPO			Other Factors *3				
1	Contractor				Other Factors *4			
1,2,3	Both					Differences *5		
1,2,3	SPO						Differences *6	
1,2,3	Contractor							Differences *7

NOTE: *(number, from 1 to 7) denotes the Research Objective linking the planning period, planning element, and Research Hypothesis.

the Research Hypotheses.

Some early validation of the interview guides was performed in an effort to assure the questions were relevant and clear, and that the choices provided on the ordinal scales were clear. As a means of performing this validation, expert opinion from people not in the sample was sought. The validation of the interview guides was performed by consulting a SPO planning element, a contractor planning element, and an Air Force Institute of Technology instructor whose specialty is logistics planning.

Data Analysis

Data analysis methodology included performing criteria testing to test the Research Hypotheses presented in Chapter 1. Criteria testing involved data comparison and statistical analysis.

The nonparametric statistical technique used, where applicable, was the Wilcoxon rank sum test. This allowed testing the general hypothesis that the probability distributions associated with two populations are equivalent by comparing sample observations from the two populations. Two assumptions were met to apply the Wilcoxon rank sum test: a) the two samples were random and independent; b) the two sets

of observations obtained could be ranked in order of magnitude. The generalized null hypothesis for this test was that the two sampled populations have identical probability distributions. The test statistic computed, the rank sum T, was determined by assigning a rank to every observation after first combining the observations from both samples. A rank of 1 was assigned to the lowest observation, a rank of two was assigned to the second lowest observation, a rank of three was assigned to the third lowest observation, etc. The rank sum T was then calculated by adding the ranks of the observations from the sample with the least number of observations. This rank sum T was then compared to tabled values (1:896) based on a selected alpha level of 0.05 for a two-tailed test. The generalized decision rule was: if T is less than or equal to the tabled value reject the null hypothesis, otherwise one cannot reject the null hypothesis.

Hypothesis Testing

The seven major hypotheses tested each have three associated subhypotheses. To test the major hypotheses, each of the subhypotheses were tested and then the results of the subhypotheses tests were combined to test the major hypotheses. For each major hypothesis and its associated set of subhypotheses, the criteria tests and implications of

results were determined.

Major Hypothesis 1

To test major hypothesis 1, subhypotheses 1A, 1B, and 1C were first tested. To test subhypothesis 1A, the SPO planning element responses to Interview Guide A questions 1, 5, 7, 9, 11, and 14 were used. Each of these questions relates to a different repair capacity planning factor. The data collected for each factor was analyzed by determining the number of responses that were greater than or equal to 4 on the given ordinal scale. This equates to a response of at least significant importance. The hypothesis that any one factor was considered to be important to the repair capacity planning process during the given period was supported if at least 75% of the responses were greater than or equal to 4 for the specific factor. Similar testing was accomplished for subhypotheses 1B and 1C using responses to Interview Guide B questions 1, 5, 7, 9, 11, and 14 and Interview Guide C questions 1, 5, 7, 9, 11, and 14 respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 1. The hypothesis that any one factor was considered to be important throughout the repair capacity planning process was supported if each of the subhypotheses was supported for the specific factor.

There are three implications of the hypothesis testing for major hypothesis 1 and its associated subhypotheses. First, if major hypothesis 1 is supported for a given factor, it can reasonably be assumed that SPO planning elements consider the factor to be important whenever planning repair capacity. Second, if major hypothesis 1 is not supported for a given factor, this factor may not be considered by SPO planning elements to be important throughout the repair capacity planning process. However, the factor may be considered important in one phase of the repair capacity planning process but not considered important in other phases. In this case the subhypotheses test results must be examined individually. Third, if none of the three subhypotheses are supported for a given factor, it can reasonably be assumed that SPO planning elements do not consider the factor to be important when planning repair capacity.

Major Hypothesis 2

To test major hypothesis 2, subhypotheses 2A, 2B, and 2C were first tested. To test subhypothesis 2A, the contractor planning element responses to Interview Guide A questions 1, 5, 7, 9, 11, and 14 were used. Each of these questions relates to a different repair capacity planning factor. The data collected for each factor was analyzed by

determining the number of responses that were greater than or equal to 4 on the given ordinal scale. This equates to a response of at least significant importance. The hypothesis that any one factor was considered to be important to the repair capacity planning process during the given period was supported if at least 75% of the responses were greater tnan or equal to 4 for the specific factor. Similar testing was accomplished for subhypotheses 2B and 2C using responses to Interview Guide B questions 1, 5, 7, 9, 11, and 14 and Interview Guide C questions 1, 5, 7, 9, 11, and 14 respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 2. The hypothesis that any one factor was considered to be important throughout the repair capacity planning process was supported if each of the subhypotheses was supported for the specific factor.

There are three implications of the hypothesis testing for major hypothesis 2 and its associated subhypotheses. First, if major hypothesis 2 is supported for a given factor, it can reasonably be assumed that contractor planning elements consider the factor to be important whenever planning repair capacity. Second, if major hypothesis 2 is not supported for a given factor, this factor may not be considered by contractor planning elements to be important

throughout the repair capacity planning process. However, the factor may be considered important in one phase of the repair capacity planning process but not considered important in other phases. In this case the subhypotheses test results must be examined individually. Third, if none of the three subhypotheses are supported for a given factor, it can reasonably be assumed that contractor planning elements do not consider the factor to be important when planning repair capacity.

Major Hypothesis 3

To test major hypothesis 3, subhypotheses 3A, 3B, and 3C were first tested. To test subhypothesis 3A, the SPO planning elements responses to Interview Guide A question 16 were used. The data collected was analyzed to determine what additional factors of importance were identified. The hypothesis that any one additional factor was considered to be important to the repair capacity planning process during the given period was supported if two or more of the respondents identified the factor. Similar testing was accomplished for subhypotheses 3B and 3C using responses to Interview Guide B question 16 and Interview Guide C question 16 respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 3. The

hypothesis that any one additional factor was considered to be important throughout the repair capacity planning process was supported if each of the subhypotheses was supported for the identified factor.

There are three implications of the hypothesis testing for major hypothesis 3 and its associated subhypotheses. First, if major hypothesis 3 is supported for a given factor, it can reasonably be assumed that the SPO planning elements consider the factor to be important whenever planning repair capacity. Second, if major hypothesis 3 is not supported for a given factor, this factor may not be considered by SPO planning elements to be important throughout the repair capacity planning process. However, the factor may be considered important in one phase of the repair capacity planning process but not considered important in other phases. In this case the subhypotheses test results must be examined individually. Third, if major hypothesis 3 is not supported for a given factor, this factor may not have occurred to all the SPO planning elements.

Major Hypothesis 4

To test major hypothesis 4, subhypotheses 4A, 4B, and 4C were first tested. To test subhypothesis 4A, the contractor planning elements responses to Interview Guide A

question 16 were used. The data collected was analyzed to determine what additional factors of importance were identified. The hypothesis that any one additional factor was considered to be important to the repair capacity planning process during the given period was supported if two or more of the respondents identified the factor. Similar testing was accomplished for Subhypotheses 4B and 4C using responses to Interview Guide B question 16 and Interview Guide C question 16 respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 4. The hypothesis that any one additional factor was considered to be important throughout the repair capacity planning process was supported if each of the subhypotheses was supported for the identified factor.

There are three implications of the hypothesis testing for major hypothesis 4 and its associated subhypotheses. First, if major hypothesis 4 is supported for a given factor, it can reasonably be assumed that the contractor planning elements consider the factor to be important whenever planning repair capacity. Second, if major hypothesis 4 is not supported for a given factor, this factor may not be considered by contractor planning elements to be important throughout the repair capacity planning process. However, the factor may be considered important in one phase of the

repair capacity planning process but not considered important in other phases. In this case the subhypotheses test results must be examined individually. Third, if major hypothesis 4 is not supported for a given factor, this factor may not have occurred to all the contractor planning elements.

Major Hypothesis 5

To test major hypothesis 5, subhypotheses 5A, 5B, and 5C were first tested. To test subhypothesis 5A, the SPO and contractor planning element responses to Interview Guide A questions 1, 5, 7, 9, 11, and 14 were used. Each of these questions relates to a different repair capacity planning factor. A Wilcoxon rank sum test was performed for each factor. To accomplish this, the SPO and contractor planning element responses for each factor were combined into one group. After combining all observations, the observations were ranked, the rank sum T was calculated, and T was compared to tabled values. The hypothesis that, for a given factor, there is a significant difference between how important the SPO planning elements consider the factor and how important the contractor planning elements consider the factor during the given period was supported by the Wilcoxon rank sum test results. Similar testing was accomplished for

subhypotheses 5B and 5C using responses to Interview Guide B questions 1, 5, 7, 9, 11, and 14 and Interview Guide C questions 1, 5, 7, 9, 11, and 14 respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 5. The hypothesis that, for a given factor, there is a significant difference between how important the SPO planning elements consider the factor and how important the contractor planning elements consider the factor throughout the repair capacity planning process was supported if each of the subhypotheses was supported for the specific factor.

There are three implications of the hypothesis testing for major hypothesis 5 and its associated subhypotheses. First, if major hypothesis 5 is supported for a given factor, it can reasonably be assumed that a significant difference exists between how important the SPO planning elements consider the factor and how important the contractor planning elements consider the factor whenever planning repair capacity. Second, if major hypothesis 5 is not supported for a given factor, a significant difference may not exist between how important a SPO planning elements consider a factor and how important the contractor planning elements consider the factor throughout the repair capacity planning process. However, a significant difference may exist in one

or two phases of the repair capacity planning process. In this case the subhypotheses test results must be examined individually. Third, if none of the three subhypotheses are supported for a given factor, it can reasonably be assumed that no significant difference exists between how important the SPO planning elements consider the factor and how important the contractor planning elements consider the factor when planning repair capacity.

Major Hypothesis 6

To test major hypothesis 6, subhypotheses 6A, 6B, and 6C were first tested. To test subhypothesis 6A, the SPO planning element responses to Interview Guide A questions 1, 5, 7, 9, 11, and 14 and the SPO planning element responses to Interview Guide B questions 1, 5, 7, 9, 11, and 14 were used. Each of these questions relates to a different repair capacity planning factor. A Wilcoxon rank sum test was performed for each factor. To accomplish this, the responses for each factor were combined into one group. After combining all observations, the observations were ranked, the rank sum T was calculated, and T was compared to tabled values. The hypothesis that, for a given factor, there is a significant difference between how important the SPO planning elements consider the factor during the first phase of the

repair capacity planning process and how important the SPO planning elements consider the factor during the second phase of the repair capacity planning process was supported by the Wilcoxon rank sum test results. Similar testing was accomplished for subhypotheses 6B and 6C using responses to questions 1, 5, 7, 9, 11, and 14 from Interview Guides A and C and Interview Guides B and C respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 6. The hypothesis that, for a given factor, there is a significant difference between how important the SPO planning elements consider the factor during the different phases of the repair capacity planning process was supported if each of the subhypotheses was supported for the specific factor.

There are three implications of the hypothesis testing for major hypothesis 6 and its associated subhypotheses. First, if major hypothesis 6 is supported for a given factor, it can reasonably be assumed that a significant difference exists between how important the SPO planning elements consider the factor during the different phases of the repair capacity planning process. Second, if major hypothesis 6 is not supported for a given factor, a significant difference between how important the SPO planning elements consider the factor during the different phases of the

repair capacity planning process may not exist. However, a significant difference may exist between two of the phases of the repair capacity planning process. In this case the subhypotheses test results must be examined individually. Third, if none of the three subhypotheses are supported for a given factor, it can reasonably be assumed that no significant difference exist between how important the SPO planning elements consider the factor during the different phases of the repair capacity planning process.

Major Hypothesis 7

To test major hypothesis 7, subhypotheses 7A, 7B, and 7C were first tested. To test subhypothesis 7A, the contractor planning element responses to Interview Guide A questions 1, 5, 7, 9, 11, and 14 and the contractor planning element responses to Interview Guide B questions 1, 5, 7, 9, 11, and 14 were used. Each of these questions relates to a different repair capacity planning factor. A Wilcoxon rank sum test was performed for each factor. To accomplish this, the responses for each factor were combined into one group. After combining all observations, the observations were ranked, the rank sum T was calculated, and T was compared to tabled values. The hypothesis that, for a given factor, there is a significant difference between how important the

contractor planning elements consider the factor during the first phase of the repair capacity planning process and how important the contractor planning elements consider the factor during the second phase of the repair capacity planning process was supported by the Wilcoxon rank sum test results. Similar testing was accomplished for subhypotheses 7B and 7C using responses to questions 1, 5, 7, 9, 11, and 14 from Interview Guides A and C and Interview Guides B and C respectively. Once all three subhypotheses were tested, the results were used to test major hypothesis 7. The hypothesis that, for a given factor, there is a significant difference between how important the contractor planning elements consider the factor during the different phases of the repair capacity planning process was supported if each of the subhypotheses was supported for the specific factor.

There are three implications of the hypothesis testing for major hypothesis 7 and its associated subhypotheses. First, if major hypothesis 7 is supported for a given factor, it can reasonably be assumed that a significant difference exists between how important the contractor planning elements consider the factor during the different phases of the repair capacity planning process. Second, if major hypothesis 7 is not supported for a given factor, a significant difference between how important the contractor plan-

ning elements consider the factor during the different phases of the repair capacity planning process may not exist. However, a significant difference may exist between two of the phases of the repair capacity planning process. In this case the subhypotheses test results must be examined individually. Third, if none of the three subhypotheses are supported for a given factor, it can reasonably be assumed that no significant difference exists between how important the contractor planning elements consider the factor during the different phases of the repair capacity planning process.

Assumptions

The following assumptions apply to this research:

(1) An individual planning element's perception of the importance of any facet of capacity planning was representative of his organization's perception.

(2) A significant difference between responses can be obtained using ordinal level data with a five point scale (7:261-265).

Limitations

The use of the study is limited by the following factors:

(1) Inferences can only be made with difficulty beyond the planning elements of ASD fighter aircraft SPOs and the planning elements of associated aerospace contractors.

(2) The research does not address whether the perceived importance of the repair capacity planning factors is "proper".

(3) This research does not address the propriety or correctness of having a government repair capacity, and does not judge if the decision to repair a given item is correct.

CHAPTER 3

FINDINGS AND CONCLUSIONS

The findings and conclusions of the study are presented in seven main parts. Each of these main parts relates to a research hypothesis. Within each main part, the major hypothesis and subhypotheses are restated, findings for the three subhypotheses are presented with reference to tables in Appendix B, corollary findings are presented, the summary of the findings for the major hypothesis are presented with reference to the tables in Appendix C, and finally, conclusions for the main hypothesis are presented. An exception to this format of presentation is made for Research Hypotheses 6 and 7 where corollary findings are omitted. These corollary findings are contained in the corollary findings for Research Hypotheses 1 and 2, respectively. Following the findings and conclusions for each of the research hypotheses, an overall summary of the findings and conclusions as they relate to the research objectives is presented.

Restatement of Research Hypothesis 1

Major Hypothesis 1

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity.

Subhypothesis 1A

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 1B

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 1C

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important

by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 1A, 1B, and 1C

Subhypothesis 1A

Table B.1 presents the ordinal responses derived from the interviews of SPO planning elements for planning period one. Testing of subhypothesis 1A, summarized in Table B.2, indicates that all factors except the division of repair and production resources and the disposition of contractor repair resources are considered important by SPO planning elements when planning repair capacity for period one.

Subhypothesis 1B

Table B.3 presents the ordinal responses derived from the interviews of SPO planning elements for planning period two. Testing of subhypothesis 1B, summarized in Table B.4, indicates that all factors except the disposition of contractor repair resources are considered important by SPO planning elements when planning repair capacity for period two.

Subhypothesis 1C

Table B.5 presents the ordinal responses derived from the interviews of SPO planning elements for planning period three. Testing of subhypothesis 1C, summarized in Table B.6, indicates that all factors except the division of repair and production resources and the disposition of contractor repair resources are considered important by SPO planning elements when planning repair capacity for period three.

Corollary Findings for Planning Factors

Repair Demand Forecasting

For period one, the SPO planning elements interviewed indicated that the procedure used to generate repair demand forecasts encompassed the use of a) contractor engineering estimates of reliability and maintainability factors such as Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR), b) past history from other aircraft acquisitions, and c) Air Force estimates of aircraft utilization. An additional finding was that, while the majority of the SPO planning elements were certain a formal model had been used to generate the repair demand forecasts, none of these formal models could be specifically identified.

For period two, the procedure used to generate repair demand forecasts was the same as for period one, but also used some actual repair data from experience during period one. As with period one, the SPO planning elements were not able to identify what formal models had been used.

During planning for period three, the procedure used to generate repair demand forecasts relied almost exclusively on actual repair data.

Ability to Forecast In-house

For period one, the SPO planning elements interviewed all indicated that the contractor was the main source of the repair demand forecasts. Additional involvement in generating these forecasts was provided by SPO logistics personnel, ALC personnel such as IMs, technicians, and production managers, and by using command maintenance personnel. Generally, Air Force personnel were involved in the validation of contractor generated repair demand forecasts.

For period two, the contractor was relied on heavily, but Air Force personnel, particularly IMs, technicians, and production managers at the organic depot repair activities, participated more fully in repair demand forecasting.

For period three, the contractor had little involvement

in repair demand forecasting, this task now being assumed by ALC personnel, particularly those involved in the organic depot repair activity.

Estimating Repair Resource Capacity

For period one, the SPO planning elements interviewed indicated that the following factors were considered when estimating the capacity of repair resources:

(1) past history of similar products;

(2) acceptance test procedures;

(3) troubleshooting procedures;

(4) average throughput time;

(5) equipment down time;

(6) operator inefficiency;

(7) learning curve phenomena; and

(8) other programs with the same repair requirements.

For period two, the same factors that were considered for period one were used, but additionally, actual experience on the equipment was very important in estimating repair capacity.

For period three, the same factors as in periods one and two were important, with the factor of design stability being added to the list.

Ability to Estimate In-house

For period one, the SPO planning elements indicated that the contractor was relied upon to provide estimates of repair resource capacity. During period two, the source of this estimating was split between the contractor, for his capacity, and the organic depot level repair activity personnel, for the capacity of organic depot level support equipment. Finally, during period three, all repair resource capacity estimating was done in-house by the organic depot repair activity.

Division of Repair and Production Resources

For period one, the SPO planning elements provided three distinct ideas on the subject of the division of repair and production resources. First, total segregation of repair and production would be ideal, but is generally not achievable due to cost constraints. Second, the contractor is bound to provide whatever repair is called for in the contract, and as long as these requirements are met there is little concern. Finally, not enough attention is given to repair, with the majority of the attention and upper-level management visibility being reserved for production.

For period two, the importance of the division of

repair and production resources is diminished because two repair capabilities are available.

For period three, the contractor may still be involved in production, but, since the majority of the repair work is accomplished by the organic depot repair facility, division of repair and production resources is not a consideration.

Disposition of Contractor Repair Resources

For period one, the SPO planning elements interviewed indicated that little planning was accomplished for the future disposition of contractor repair resources. For period two, this lack of planning continued in some instances and, in other cases, plans were formulated to transfer contractor repair resources to the organic depot. No change in this approach was evident during planning for period three.

Summary Findings for Major Hypothesis 1

Table C.1 contains a summary of the hypothesis test decisions for subhypotheses 1A, 1B, and 1C. Testing of major hypothesis 1 indicates that all factors except the division of repair and production resources and the disposition of contractor repair resources are considered important by SPO planning elements when planning repair capacity.

Conclusions for Major Hypothesis 1

When planning for repair capacity, SPO planning elements consider the following factors to be important: a) repair demand forecasting, b) the ability to forecast in-house, c) estimating repair resource capacity, and d) the ability to estimate in-house. SPO planning elements do not consider the factor of the division of repair and production resources to be important except when planning repair capacity for period two. Further, the SPO planning elements do not consider the disposition of contractor repair resources important when planning repair capacity.

Restatement of Research Hypothesis 2

Major Hypothesis 2

The factors of a) repair demand forecasting and the source of this forecast, b) estimating repair resource capacity and the source of this estimate, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity.

Subhypothesis 2A

The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by con-

tractor special test equipment.

Subhypothesis 2B

> The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 2C

> The factors of a) repair demand forecasting and the ability to forecast in-house, b) estimating repair resource capacity and the ability to estimate in-house, c) the division of repair and production resources, and d) the disposition of contractor repair resources were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 2A, 2B, and 2C

Subhypothesis 2A

Table B.7 presents the ordinal responses derived from the interviews of contractor planning elements for planning period one. Testing of subhypothesis 2A, summarized in Table B.8, indicates that all factors except the disposition of contractor repair resources are considered important by contractor planning element when planning repair capacity

for period one.

Subhypothesis 2B

Table B.9 presents the ordinal responses derived from the interviews of contractor planning elements for planning period two. Testing of subhypothesis 2B, summarized in Table B.10, indicates that all factors are considered important by contractor planning elements when planning repair capacity for period two.

Subhypothesis 2C

Table B.11 presents the ordinal responses derived from the interviews of contractor planning elements for planning period three. Testing of subhypothesis 2C, summarized in Table B.12, indicates that only the factor of estimating repair resource capacity is considered important by contractor planning elements when planning repair capacity for period three.

Corollary Findings for Planning Factors

Repair Demand Forecasting

For period one, the contractor planning elements interviewed indicated that the procedure used to generate repair

demand forecasts encompassed the use of a) contractor engineering estimates of reliability and maintainability factors such as MTBF and MTTR, b) past history from other aircraft acquisitions, and c) Air Force estimates of aircraft utilization. This held for two of the three systems considered in the study, however, for the third system, the contractor planning elements indicated that no forecasting of repair demand was done. Also for two of the three contractors interviewed, the planning elements indicated no formal model was used to forecast repair demand and the other contractor indicated a formal model had been used but was unable to identify the model.

For period two, the procedure used to generate repair demand forecasts was the same as for period one, but also included some actual repair experience gathered during period one. No change in the use of formal models to forecast repair demand was evidenced in period two.

During planning for period three one contractor indicated involvement in repair demand forecasting had not changed from period two. However, the other two contractors indicated involvement in repair demand forecasting was limited to providing repair data to the Air Force. No formal models were used by contractor planning elements for this

period.

Ability to Forecast In-house

For period one, the contractor planning elements interviewed indicated that logistics, engineering, and subcontract management personnel from the prime contractor as well as subcontractor personnel were involved in repair demand forecasting. For periods two and three no changes were identified.

Estimating Repair Resource Capacity

For period one, the contractor planning elements interviewed indicated that the following factors were considered when estimating the capacity of repair resources:

(1) average throughput time;

(2) equipment down time;

(3) past experience on similar products;

(4) other programs with similar repair requirements; and

(5) the effects of weather on repair resource performance.

For periods two and three, the same factors that were considered during period one were used. However, actual

experience was identified as an additional factor of importance.

Ability to Estimate In-house

For all periods, the contractor planning elements interviewed indicated that the main source of repair resource capacity estimates was from subcontractors with the prime contractor engineering, manufacturing, quality control, and subcontract management personnel validating the estimates.

Division of Repair and Production Resources

The contractor planning elements considered the division of repair and production resources to be of at least significant importance during periods one and two for a variety of reasons. Included were:

(1) production and repair are different activities and should be kept separate;

(2) conducting repair and production using the same resources, especially when repair is on a non-interference basis, is a disrupting factor equated with non-planning on the part of the Air Force; and

(3) separate repair and production resources allow the con-

tractor to properly utilize manpower, facilities, equipment, and tooling.

For period three, the division of repair and production resources assumed considerably less importance because the contractor no longer provides any significant amount of repair.

Disposition of Contractor Repair Resources

For two of the three contractors interviewed, no planning was accomplished for the disposition of contractor repair resources throughout the three periods. The other contractor indicated that planning for the disposition of contractor repair resources was accomplished during all periods. The general plan was to transfer contractor equipment to the organic depot repair facility when applicable.

Summary Findings for Major Hypothesis 2

Table C.2 contains a summary of the hypothesis test decisions for subhypotheses 2A, 2B, and 2C. Testing of major hypothesis 2 indicates that only the factor of estimating repair resource capacity is considered important by contractor planning elements when planning repair capacity.

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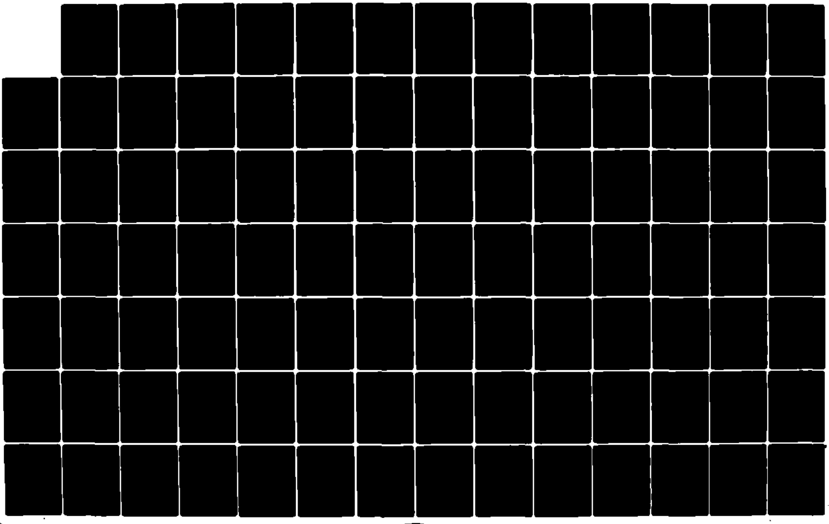

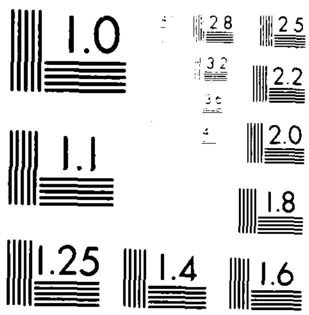

MICROCOPY RESOLUTION TEST CHART

Conclusions for Major Hypothesis 2

When planning for repair capacity, contractor planning elements consider only the factor of estimating repair resource capacity to be important. Contractor planning elements did not consider the following factors to be important except when planning repair capacity for periods one and two: a) repair demand forecasting, b) having an in-house capability to generate repair demand forecasts, c) having an in-house capability to estimate repair resource capacity, and d) the division of repair and production resources. Further, contractor planning elements do not consider the factor of the disposition of contractor repair resources to be important except when planning repair capacity for period two.

Restatement of Research Hypothesis 3

Major Hypothesis 3

Other factors were considered important by SPO planning elements when they were planning repair capacity.

Subhypothesis 3A

Other factors were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 3B

Other factors were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 3C

Other factors were considered important by SPO planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 3A, 3B, and 3C

Subhypothesis 3A

At least two of the SPO planning elements interviewed considered the following factors to be of at least significant importance when planning repair capacity for period one:

(1) Planning for repair capacity should be accomplished in conjunction with planning for the capacity required to manufacture production items and spare parts.

(2) Component parts necessary to accomplish repair should be available and the ability of the government or the contractor to obtain these parts should be considered.

(3) A system for the contractor to report failure data to

the government should be established.

Subhypothesis 3B

At least two of the SPO planning elements interviewed considered the following factors to be of at least significant importance when planning repair capacity for period two:

(1) Component parts necessary to accomplish repair should be available and the ability of the government or the contractor to obtain these parts should be considered.

(2) A system for the contractor and field repair agencies to report failure data should be established.

(3) Technical data necessary to accomplish repair should be available.

Subhypothesis 3C

At least two of the SPO planning elements interviewed considered the following factors to be of at least significant importance when planning repair capacity for period three:

(1) Component parts necessary to accomplish repair should be available and the ability of the government to

obtain these parts should be considered.

(2) Technical data necessary to accomplish repair should be available.

(3) Data regarding the system's repair history should be available.

(4) Training of organic depot level repair agency personnel should be considered.

(5) Facilities necessary to accomplish repair at the organic depot level repair agency should be available.

Corollary Findings for Other Planning Factors

For period one, the following factors were identified as being of at least significant importance, however, each of the factors was mentioned by only one of the SPO planning elements interviewed:

(1) the terms and conditions of repair contracts;

(2) repair contract management and administration;

(3) contractor past performance;

(4) the quantity of intermediate level repair to be accomplished by the contractor during initial activation of

the system;

(5) subcontractor repair capacity;

(6) ALC involvement in repair demand forecasting;

(7) early planning to design contractor special test equipment to allow transfer to organic depot;

(8) SPO logistics personnel, in key management positions, should have maintenance experience; and

(9) a good maintenance plan, generated early in the program.

For period two, the only factor identified as being of at least significant importance and mentioned by only one SPO planning element was the need for a good maintenance plan.

For period three, the following factors were identified as being of at least significant importance, however, each of the factors was mentioned by only one of the SPO planning elements interviewed:

(1) weapon system design stability;

(2) a good maintenance plan; and

(3) contractor involvement in training Air Force personnel in organic depot level support equipment operation, as well as contractor operation and maintenance of the equipment during the training period

Another factor discovered during this research was the need for an interaction between the major government and industry agencies responsible for repair capacity planning. This interaction is required to assure sufficient capacity for manufacturing of production end items and spare parts while maintaining adequate capability for the repair and modification of aircraft parts necessary to meet both production and support requirements. The F-16 SPO has established a cooperative planning program to promote this interaction. The specific actions of the F-16 cooperative planning program include: a) the analysis of firm and potential requirements to identify source capability; b) identifying management actions required for problem solution and prevention; c) initiating joint reviews to evaluate both long and near term critical capacity shortages; and d) identifying sources where no current capacity limitations exist. These objectives and actions are met by developing long range consolidated item demand forecasts for installation, spares, repairs, and modification. Figure 3.1 shows the relationship between this cooperative planning effort and

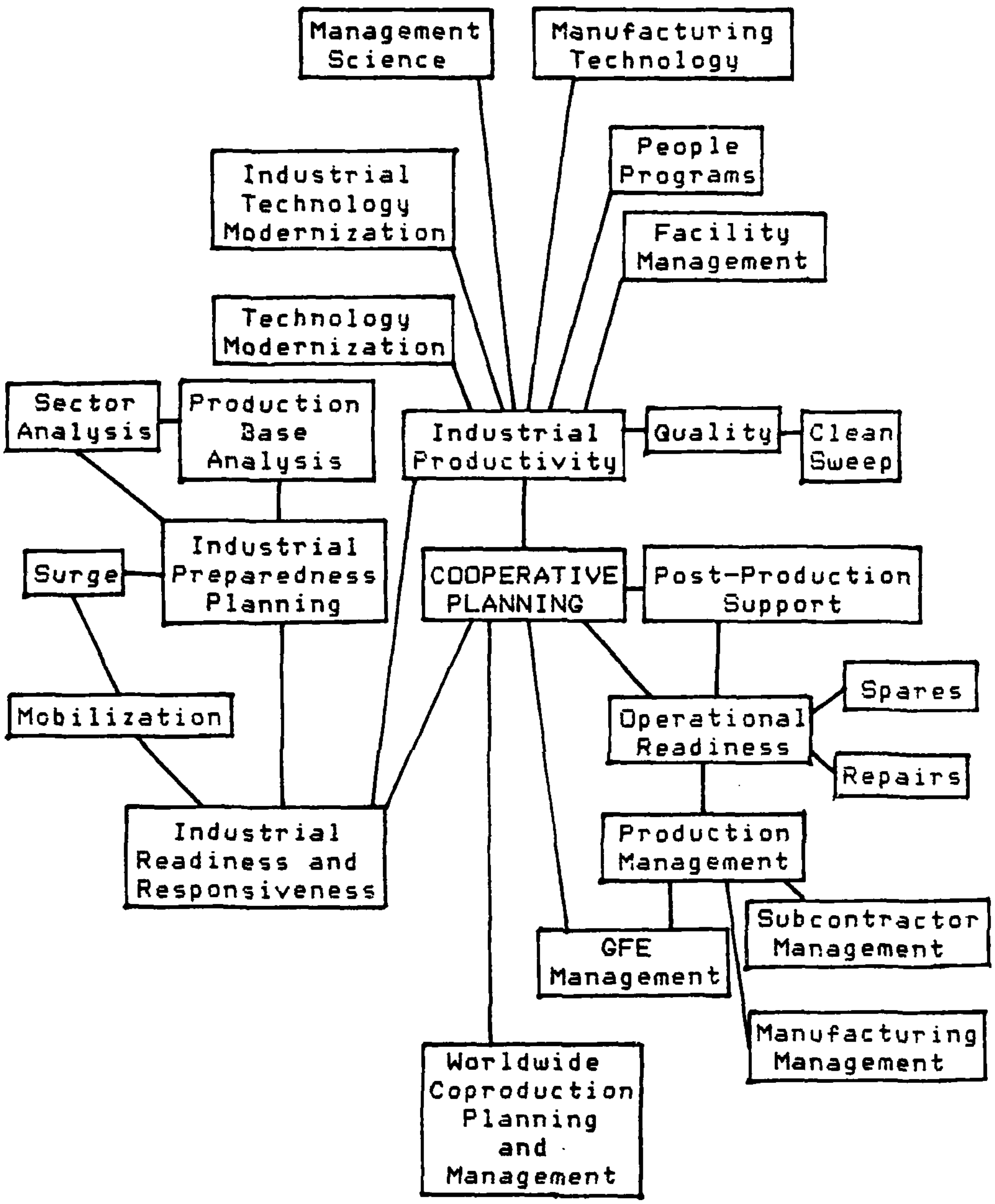

FIGURE 3.1

Potential Uses of Cooperative Planning Data

other industrial management activities.

Summary Findings for Major Hypothesis 3

The following factors are considered important by SPO planning elements throughout the repair capacity planning process:

(1) Component parts necessary to accomplish repair should be available and the ability of the government or the contractor to obtain these parts should be considered.

(2) A system to accumulate data regarding the system's repair history should be established.

Conclusions for Major Hypothesis 3

While the SPO planning elements identified a limited number of factors as being of at least significant importance during all repair capacity planning periods, a greater number of factors were identified as being of at least significant importance in only one or two of the planning periods. Also, a much larger number of factors were identified as being of at least significant importance by only one SPO planning element interviewed. It is hypothesized that this was due to either limited personal experience within the group of SPO planning elements sampled or the factors

may not have been recalled at the time of the interview.

Restatement of Research Hypothesis 4

Major Hypothesis 4

> Other factors were considered important by contractor planning elements when they were planning repair capacity.

Subhypothesis 4A

> Other factors were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 4B

> Other factors were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 4C

> Other factors were considered important by contractor planning elements when they were planning repair capacity for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 4A, 4B, and 4C

Subhypothesis 4A

At least two of the contractor planning elements interviewed considered the following factors to be of at least significant importance when planning repair capacity for

period one:

(1) Component parts necessary to accomplish repair should be available and the ability of the government or the contractor to obtain these parts should be considered.

(2) Reparable SRUs and LRUs should be shipped to the depot level repair agency as they are generated.

(3) The contractor should be provided with information regarding planned system operational usage.

(4) For components or subsystems that the prime contractor obtains from suppliers, the prime should be notified by the government of all requirements placed on the supplier by the government.

Subhypothesis 4B

At least two of the contractor planning elements interviewed considered the following factors to be of at least significant importance when planning repair capacity for period two:

(1) Component parts necessary to accomplish repair should be available and the ability of the government or the contractor to obtain these parts should should be established.

(2) Establish a communications link between the contractor and the relevant ALCs, to include establishing formal transition conferances.

(3) Design and configuration changes should be controlled.

Subhypothesis 4C

At least two of the SPO planning elements interviewed considered the following factors to be of at least si' 'ifi- cant importance when planning repair capacity for riod three:

(1) Component parts necessary to accomplish repair should be available and the ability of the government to obtain these parts should be considered.

(2) Technical data necessary to accomplish repair should be available.

(3) Training of organic depot level repair agency personnel should be considered.

(4) Facilities necessary to accomplish repair at the organic depot level repair agency should be available.

(5) The government should keep the contractor involved to help with solving problems during the initial stages of

total organic depot repair.

Corollary Findings for Other Planning Factors

For period one, the following factors were identified as being of at least significant importance, however, each of the factors was mentioned by only one of the contractor planning elements interviewed:

(1) funding of contractor special test equipment;

(2) tracking location and status of reparable items;

(3) collection of failure data, specifically information regarding what actually caused the failure and why;

(4) fragmentation of authority between ALCs, SMs, and IMs;

(5) the terms and conditions of repair contracts; and

(6) repair contract management and administration.

For period two, the following factors were identified as being of at least significant importance, however, each of the factors was mentioned by only one of the contractor planning elements interviewed:

(1) funding of contractor special test equipment;

(2) timing of the withdrawal of the contractor from the

repair process;

(3) amount of ALC participation prior to Program Management Responsibility Transfer (PMRT);

(4) how reparable items are allocated to the two repair facilities (contractor and organic);

(5) fragmentation of authority between ALCs, SMs, and IMs;

(6) the terms and conditions of repair contracts; and

(7) repair contract management and administration.

For period three, the following factors were identified as being of at least significant importance, however, each of the factors was mentioned by only one of the contractor planning elements interviewed:

(1) timing of the withdrawal of the contractor from the repair process;

(2) retrofit of weapon system components; and

(3) fragmentation of authority between ALCs, SMs, and IMs.

Summary Findings for Major Hypothesis 4

The following factor was considered important by con-

planning process: component parts necessary to accomplish repair should be available and the ability of the government or the contractor to obtain these parts should be considered.

Conclusions for Major Hypothesis 4

While the contractor planning elements identified a limited number of factors as being of at least significant importance during all repair capacity planning periods, a greater number of factors were identified as being of at least significant importance in only one or two of the planning periods. Also, a much larger number of factors were identified as being of at least significant importance by only one contractor planning element interviewed. It is hypothesized that this was due to either limited personal experience within the group of contractor planning elements sampled or the factors may not have been recalled at the time of the interview.

Restatement of Research Hypothesis 5

Major Hypothesis 5

> There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the contractor elements.

Subhypothesis 5A

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the factors considered important by the contractor planning elements when planning for the period when depoc level repair is to be provided exclusively by contractor special test equipment.

Subhypothesis 5B

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the factors considered important by the contractor planning elements when planning for the period when depot level repair is to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 5C

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements and the factors considered important by the contractor planning elements when planning for the period when depot level repair is to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 5A, 5B, and 5C

Subhypothesis 5A

Table B.13 presents the ordinal responses derived from the interviews of SPO and contractor planning elements for planning period one. Testing of subhypothesis 5A, summarized in Table B.14, indicates that the Null hypothesis can only be rejected for the factors of 1) estimating repair resource capacity and 2) the division of repair and produc-

tion resources. This means that there is a significant difference in how important the SPO planning elements consider these factors and how important the contractor planning elements consider these factors when planning for period one.

Subhypothesis 5B

Table B.15 presents the ordinal responses derived from the interviews of SPO and contractor planning elements for planning period two. Testing of subhypothesis 5B, summarized in Table B.16, indicates that the Null hypothesis can only be rejected for the factor of the division of repair and production resources. This means that there is a significant difference how important the SPO planning elements consider this factor and how important the contractor planning elements consider this factor when planning for period two.

Subhypothesis 5C

Table B.17 presents the ordinal responses derived from the interviews of SPO and contractor planning elements for period three. Testing of subhypothesis 5C, summarized in Table B.18, indicates that the Null hypothesis can only be rejected for the factor of the division of repair and pro-

duction resources. This means that there is a significant difference how important the SPO planning elements consider this factor and how important the contractor planning elements consider this factor when planning for period three.

Corollary Findings for Planning Factors

Repair Demand Forecasting

While there was no difference between how the SPO planning elements perceived the procedure used to generate repair demand forecasts and the contractor planning elements' perception of this procedure, there were some discrepancies. The first discrepancy was related to the use of formal models. The SPO planning elements overwhelmingly indicated that formal models were used to forecast repair demand while the exact opposite response was obtained from the contractor planning elements. The second discrepancy was related to the contractor's involvement in repair demand forecasting. The SPO planning elements indicated that the contractor was relied on to provide the forecasts while the contractor planning elements for one of the weapon systems studied indicated that they were not involved in repair demand forecasting during any of the three planning periods, and were actively excluded from participation during period

three planning.

Ability to Forecast In-house

For period one, the SPO planning elements interviewed all indicated the contractor was heavily involved in forecasting but were unable to identify the types of contractor personnel involved. While the SPO planning elements indicated there was some Air Force involvement in repair demand forecasting, the contractor planning elements did not identify any Air Force involvement except in period three.

Estimating Repair Resource Capacity

For all periods, five factors used to estimate the capacity of repair resources were identified by both SPO and contractor planning elements. These factors were:

(1) past history of similar products;

(2) average throughput time;

(3) equipment down time;

(4) other programs with the same repair requirements; and

(5) actual experience gained during use of the repair resources.

Ability to Estimate In-house

For the first two periods, the SPO and contractor planning elements agreed that the contractor was the main source of repair resource capacity estimates. However, for period three, the SPO planning elements indicated that estimating was accomplished as a total in-house effort, while the contractor planning elements indicated that they were also involved.

Division of Repair and Production Resources

The main difference between the SPO and contractor planning elements regarding the division of repair and production resources was that while both planning elements felt total separation was ideal, the SPO planning elements felt total separation was not feasible due to cost constraints and the contractor planning elements felt total separation was worth the significant initial investment.

Disposition of Contractor Repair Resources

There was no disagreement between the SPO and contractor planning elements regarding how planning for the disposition of contractor repair resources had been done.

Summary Findings for Major Hypothesis 5

Table C.3 contains a summary of the Null hypothesis test decisions for subhypotheses 5A, 5B, and 5C. Testing of major hypothesis 5 indicates that only for the factor of the division of repair and production resources is the major hypothesis supported.

Conclusions for Major Hypothesis 5

Since major hypothesis 5 is supported for the factor of the division of repair and production resources, there is a significant difference in how important this factor is considered by SPO and contractor planning elements when planning repair capacity.

Restatement of Research Hypothesis 6

Major Hypothesis 6

> There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements whether planning for depot level repair to be provided exclusively by contractor special test equipment, planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment, or planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 6A

> There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements when planning

for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 6B

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 6C

There is a significant difference between the repair capacity planning factors considered important by the SPO planning elements when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 6A, 6B, and 6C

Subhypothesis 6A

Table B.19 presents the ordinal responses derived from the interviews of SPO planning elements for planning periods one and two. Testing of subhypothesis 6A, summarized in Table B.20, indicates that the Null hypothesis can only be rejected for the factor of the division of repair and production resources. This means that there is a significant

difference between how important the SPO planning elements considered the factor of the division of repair and production resources when planning for period one and when planning for period two.

Subhypothesis 6B

Table B.21 presents the ordinal responses derived from the interviews of SPO planning elements for planning periods one and three. Testing of subhypothesis 6B, summarized in Table B.22, indicates that the Null hypothesis cannot be rejected for any of the factors of interest. This means that there is no significant difference between how important the SPO planning elements consider any of the factors when planning for period one and when planning for period three.

Subhypothesis 6C

Table B.23 presents the ordinal responses derived from the interviews of SPO planning elements for planning periods two and three. Testing of subhypothesis 6C, summarized in Table B.24, indicates that the Null hypothesis can only be rejected for the factor of the division of repair and production resources. This means that there is a significant difference between how important the SPO planning elements

consider the factor of the division of repair and production resources when planning for period two and when planning for period three.

Summary Findings for Major Hypothesis 6

Table C.4 contains a summary of the Null hypothesis test decisions for subhypotheses 6A, 6B, and 6C. Testing of major hypothesis 6 indicates that there is no support of this hypothesis for any of the factors of interest.

Conclusions for Major Hypothesis 6

Since major hypothesis 6 is not supported for any of the factors of interest, there is no significant difference in how important the factors are considered to be by SPO planning elements between planning periods. However, the factor of the division of repair and production resources was found to be considered more important when planning for period two than during either of the other two planning periods.

Restatement of Research Hypothesis 7

Major Hypothesis 7

> There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements whether planning for depot level repair to be provided exclusively by contractor special test equipment,

planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment, or planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 7A

There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment.

Subhypothesis 7B

There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements when planning for depot level repair to be provided exclusively by contractor special test equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

Subhypothesis 7C

There is a significant difference between the repair capacity planning factors considered important by the contractor planning elements when planning for depot level repair to be provided by both contractor special test equipment and organic depot level support equipment and when planning for depot level repair to be provided exclusively by organic depot level support equipment.

Findings for Subhypotheses 7A, 7B, and 7C

Subhypothesis 7A

Table B.25 presents the ordinal responses derived from the interviews of contractor planning elements for periods one and two. Testing of subhypothesis 7A, summarized in Table B.26, indicates that the Null hypothesis cannot be rejected for any of the factors. This means that there is not a significant difference between how important the contractor planning elements considered any one factor when planning for period one and when planning for period two.

Subhypothesis 7B

Table B.27 presents the ordinal responses derived from the interviews of contractor planning elements for periods one and three. Testing of subhypothesis 7B, summarized in Table B.28, indicates that the Null hypothesis can only be rejected for the factor of the division of repair and production resources. This means that there is a significant difference between how important the contractor planning elements consider the factor of the division of repair and production resources when planning for period one and when planning for period three.

Subhypothesis 7C

Table B.29 presents the ordinal responses derived from the interviews of contractor planning elements for periods two and three. Testing of subhypothesis 7C, summarized in Table B.30, indicates that the Null hypothesis can only be rejected for the factor of the division of repair and production resources. This means that there is a significant difference between how important the contractor planning elements consider the factor of the division of repair and production resources when planning for period two and when planning for period three.

Summary Findings for Major Hypothesis 7

Table C.5 contains a summary of the Null hypothesis test decisions for subhypotheses 7A, 7B, and 7C. Testing of major hypothesis 7 indicates that there is no support of this hypothesis for any of the factors of interest.

Conclusions for Major Hypothesis 7

Since major hypothesis 7 is not supported for any of the factors of interest, there is no significant difference in how important the factors are considered to be by contractor planning elements between planning periods. However, the factor of the division of repair and production

resources was found to be considered more important when planning for periods one and two than when planning for period three.

Summary Findings

Research Objective 1

The factors of a) repair demand forecasting, b) the ability to forecast in-house, c) estimating repair resource capacity, and d) the ability to estimate in-house are considered important by SPO planning elements when they are planning repair capacity.

Research Objective 2

The factor of estimating repair resource capacity is considered important by contractor planning elements when they are planning repair capacity.

Research Objective 3

The factors of a) component parts necessary to accomplish repair being available and the ability of the government or the contractor to obtain these parts and b) a system to accumulate data regarding the system's repair history are other factors considered important by SPO planning elements

when they are planning repair capacity.

Research Objective 4

The factor of component parts necessary to accomplish repair being available and the ability of the government or the contractor to obtain these parts is one other factor considered important by contractor planning elements when they are planning repair capacity.

Research Objective 5

A difference exists in repair capacity planning as performed by SPO planning elements and contractor planning elements when planning for the division of repair and production resources.

Research Objective 6

There is no difference in repair capacity planning as performed by SPO planning elements during the three distinct periods characterized by the source of depot level repair capacity.

Research Objective 7

There is no difference in repair capacity planning as performed by contractor planning elements during the three

distinct periods characterized by the source of depot level repair.

Summary Conclusions

Research Objective 1

The researchers conclude that managers emphasize the factors of a) repair demand forecasting, b) the ability to forecast in-house, c) estimating repair resource capacity, and d) the ability to estimate in-house during the planning for repair capacity.

Research Objective 2

The researchers conclude that the factor of estimating repair resource capacity is given special emphasis during the planning for repair capacity.

Research Objective 3

The researchers conclude that managers also emphasize the factors of a) component parts necessary to accomplish repair being available and the ability of the government or the contractor to obtain these parts and b) a system to accumulate data regarding the system's repair history during the planning for repair capacity. Further, the researchers conclude that many other factors are considered when plan-

ning repair capacity, but are not universally emphasized.

Research Objective 4

The researchers conclude that the factor of component parts necessary to accomplish repair being available and the ability of the government or the contractor to obtain these parts is given special emphasis during the planning for repair capacity.

Research Objective 5

The researchers conclude that no major difference exists between the factors emphasized by SPO planning elements and contractor planning elements during the planning for repair capacity.

Research Objective 6

The researchers conclude that the source of depot level repair capacity does not effect the factors emphasized by SPO planning elements when planning repair capacity.

Research Objective 7

The researchers conclude that the source of depot level repair capacity does not effect the factors emphasized by contractor planning elements when planning repair capacity.

Overall Conclusion

The overall conclusion from this study is that neither the SPO planning elements nor the contractor planning elements have available to them a clear and standardized definition of the goals and means of accomplishing repair capacity planning.

CHAPTER 4

OBSERVATIONS AND RECOMMENDATIONS

Introduction

Because the general revelation of this thesis was that no clear and standardized definition of what the expectations of repair capacity planning should be is available, the following observations and recommendations are presented. These observations and recommendations are divided into two categories - primary and corollary. The primary observations and recommendations are concerned with, first, the recommendations resulting from the findings and conclusions for the seven research objectives, and, second, furthering the effort begun by this thesis. The corollary observations and recommendations cover the areas of professionalism, economic acquisition of repair capacity, and contractual arrangements. Finally, this chapter presents concluding remarks regarding repair capacity planning expectations.

Primary Observations and Recommendations

As a result of the findings and conclusions established for the seven research objectives of this thesis, the

researchers recommend that management compile and publish a guide that identifies those factors that should be considered by managers involved in repair capacity planning. As an initial step in compiling this guide, immediate action should be taken to gather lessons learned from experienced managers in both government and industry. In keeping with the findings and conclusions established for Research Objectives 1, 2, 3, and 4, this guide should emphasize the factors of a) repair demand forecasting, b) the ability to forecast in-house, c) estimating repair resource capacity, d) the ability to estimate in-house, e) component parts necessary to accomplish repair being available and the ability of the government or the contractor to obtain these parts, and f) a system to accumulate data regarding the system's repair history. Because Research Objective 5 showed that no major differences exist between SPO and contractor management of repair capacity planning, this guide should be made available to both government and industry managers. Finally, because Research Objectives 6 and 7 showed that the source of depot level repair did not effect either the SPO or contractor management of repair capacity planning, the guide should be applicable to the planning of any depot level repair capacity.

The scope of this study included three fighter aircraft

acquisition programs currently being managed by ASD. These three programs do not provide conclusive evidence that the findings and conclusions can be applied to all ASD managed fighter aircraft acquisition programs, to other ASD managed programs, or to programs that are not the responsibility of ASD. The structure of this research effort appears to have been validated and is capable of replication. Therefore, it is recommended that the study be replicated a) with additional ASD managed fighter aircraft acquisition programs, b) with other ASD managed weapon system acquisition programs, and c) with programs not the responsibility of ASD.

In addition to replicating this research, further research has been suggested by this study. One recommendation for additional research is to increase the number of population parameters to be studied to include those other factors identified in the findings and conclusions associated with the determination of other factors to be considered when planning repair capacity. Another recommendation is to determine the rank order of importance of these parameters.

Corollary Observations and Recommendations

Professionalism

Observations

As a result of this study, three observations were made by the researchers concerning the degree of professionalism associated with both government and defense industry planning and management of repair capacity. First, interview comments from SPO and contractor planning elements indicated a lack of corporate knowledge existed. This observation was supported by the fact that a large number of the SPO and contractor planning elements contacted were no longer directly associated with the program for which they at one time had repair capacity planning responsibility. Further, the large number of repair capacity planning factors that were mentioned by only one planning element indicates a lack of planning element cross-communication. Second, the general lack of a formally structured organization dedicated to repair capacity planning and management was observed. This observation was true of both the government and defense industry contractors. Third, and of a broader nature, is the observation that repair capacity planning and management has not been characterized by the type of forward, innovative thinking that has been applied to the management of other

subprocesses within the acquisition process.

Recommendations

The recommendations regarding the observations bearing on the area of professionalism fall into two categories - research recommendations and management recommendations. The researchers recommend two studies: a) a study to determine what data is available and should be collected to provide repair capacity planning elements with a corporate data base for future weapon system acquisitions; and b) a study to determine what functional areas of expertise need to be incorporated into both the government and contractor repair capacity planning and management organizations. The researchers also recommend the following management actions: a) based on the results of the previously recommended data base identification study, establish a corporate repair capacity planning and management data base; b) define and implement policy that would establish a dedicated government repair capacity planning and management organization incorporating those functional areas of expertise identified in the previously recommended study; and c) provide funding for a dedicated contractor repair capacity planning and management organization.

Economic Acquisition of Repair Capacity

Observations

As a result of this study, and drawing from published literature, five observations were made concerning the economics of acquiring repair capacity. First, while DoD has made some financial investment in contractor special test equipment and organic depot level support equipment, no specific information is available regarding the size of this investment. Second, there is a lack of design compatibility between contractor special test equipment and organic depot level support equipment. Third, as a result of this design incompatibility , a duplication of repair capacity may occur, especially during period two when both types of equipment are in use. Fourth, a high degree of uncertainty exists regarding actual repair capacity available from either contractor or government sources. Finally, a high degree of uncertainty also exists regarding the actual demand for repair capacity.

Recommendations

The recommendations regarding the observations bearing on the area of the economics of repair capacity acquisition fall into two categories - research recommendations and

management recommendations. The researchers recommend three studies: a) a study to quantify the costs associated with the acquisition of contractor special test equipment and organic depot level support equipment; b) a related study to identify the costs associated with acquiring contractor special test equipment that is designed to be compatible with organic depot level repair requirements; and c) a study to determine and compare actual repair capacity availability and actual repair capacity requirements over the life cycle of a weapon system. The researchers also recommend the following management action: establish a policy to allow organic depot level support equipment to be designed to commercial standards and thus allow the direct transfer of contractor special test equipment to organic depot level repair facilities.

Contractual Arrangements

Observations

As a result of this study, three observations were made concerning the contractual arrangements between the government and the defense industry to obtain repair of weapon system components. First, the initial proposal for weapon system production is not required to include provisions for repair. Second, the defense contractor is constrained by

both the terms and conditions and the administration of repair contracts. The two most notable constraints being a) funding and availability of component parts and b) the overall level of government involvement. Third, a lack of government concern exists regarding the division of repair and production resources.

Recommendations

The recommendations regarding the observations bearing on the area of contractual arrangements fall into two categories - research recommendations and management recommendations. The researchers recommend four studies: a) a study to determine the benefits and detriments of the division of repair and production resources; b) a study to determine the benefits and detriments of establishing repair capabilities at the prime contractor's facility to accomplish repair of components supplied by the government or subcontractors, these capabilities being commonly known as Special Repair Activities (SRA); c) a study to develop an economic decision model that would examine component reliability and the costs associated with establishing an SRA, and would permit a break even analysis to be accomplished; and d) a study to determine what contractual arrangements could be used to reduce the constraints imposed on the con-

tractor, within the constraints of effective management of government repair contracts. The researchers also recommend the following management actions: a) establish a policy to require the incorporation of repair into initial weapon system acquisition proposals and to encourage this by the use of multiyear contracting; and b) establish a policy, within the bounds of accountability and responsibility, to encourage a wider latitude in the terms and conditions and administration of repair contracts, to include a wider acceptance of SRAs, repair parts funding and availability, and the division of repair and production resources.

Concluding Remarks

The basic problem addressed in this thesis is the lack of emphasis given to repair capacity planning. The previously presented findings and observations have identified some of the specific symptoms associated with this problem. The summary conclusion of Chapter 3 identifies what the researchers feel is a possible explanation of one of the main sources of this problem. This conclusion, a general revelation of the study, was that no clear and standardized definition of what the expectations of repair capacity planning should be is available to either the SPO or contractor planning elements.

As a start toward this definition, the model presented in Figure 4.1 identifies a number of the parameters that must be considered when planning repair capacity. This model is not intended to represent the entire repair capacity planning process and requires a considerable amount of further research, refinement, and explanation. While this model, and any future models, would aid in providing the needed definition of repair capacity planning expectations, many other dimensions need to be explored to provide a complete definition.

The researchers feel that if management will implement the proposed recommendations and direct the proposed research, one of the major causes of the lack of emphasis on repair capacity planning will be greatly alleviated.

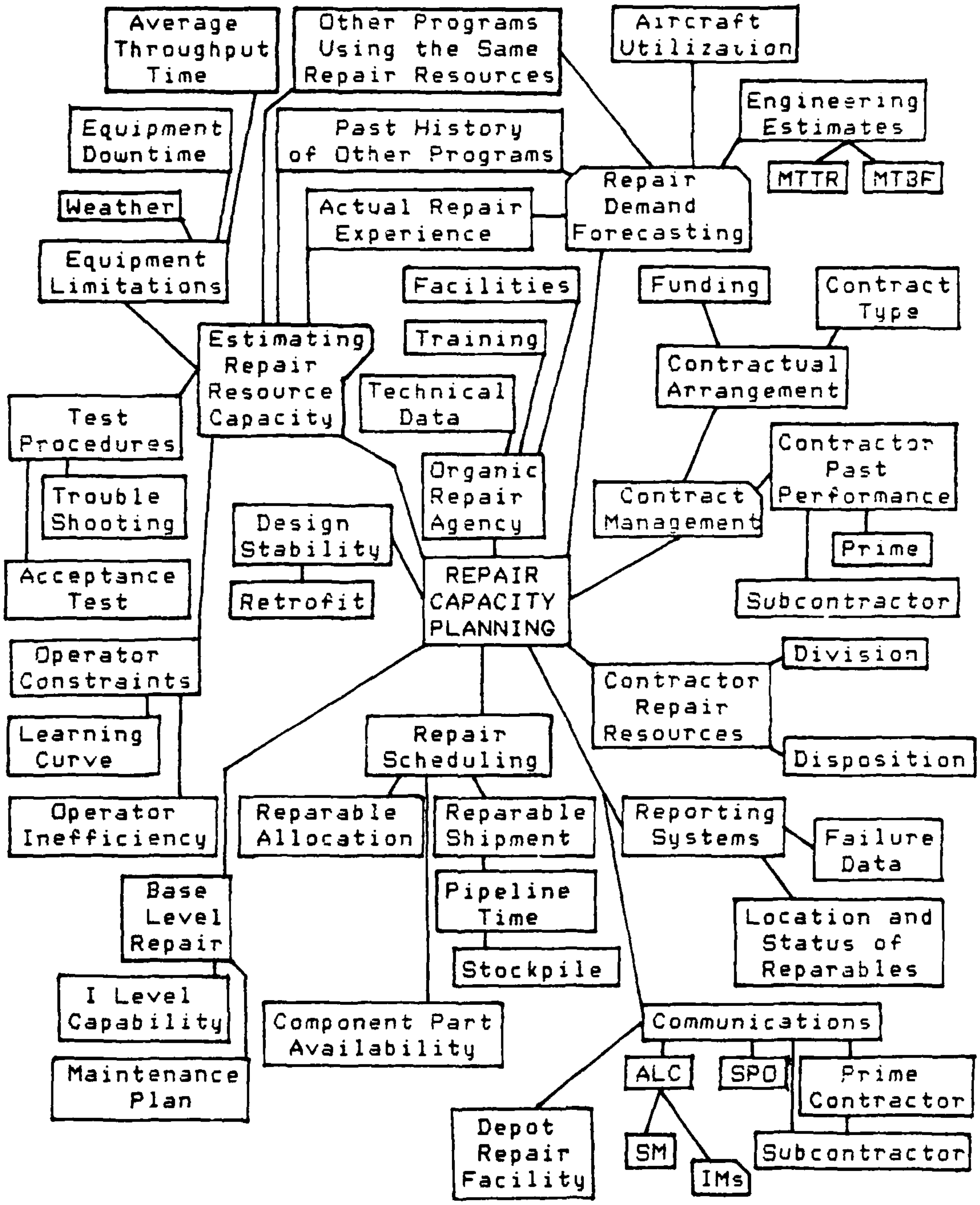

FIGURE 4.1

Normative Model of Repair Capacity Planning

APPENDICES

APPENDIX A

INTERVIEW GUIDES

INTERVIEW GUIDE A

During the period when it was planned to have contractor special test equipment provide depot level repair of the subsystem:

(1) How important do you consider forecasting of repair demand to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(2) Briefly describe the procedure used to generate the repair demand forecast.

(3) Was a formal model used?

(4) What was the model?

(5) How important do you consider it to be to have an in-house capability to generate a repair demand forecast for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(6) Briefly describe who was involved with forecasting repair demand.

(7) How important do you consider estimating the capacity of the resources programmed to meet the demands generated by repair requirements for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(8) What factors were considered when estimating the capacity of repair resources?

(9) How important do you consider it to be to have an in-house capability to estimate repair resource capacity for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(10) Briefly describe who was involved when estimating repair resource capacity.

(11) How important do you consider the division of repair and production resources to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(12) Why do you feel this way?

(13) What was the division of repair and production resources?

(14) How important do you consider the disposition of contractor repair resources to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(15) What was the plan for the disposition of contractor repair resources?

(16) What other factors do you consider to be of at least significant importance relative to repair capacity planning for this period?

(17) How well did the repair capacity planning process work?

(18) Were there any problems?

(19) What other comments or recommendations do you have regarding repair capacity planning or repair management?

INTERVIEW GUIDE B

During the period when it was planned to have both contractor special test equipment and organic depot level support equipment provide depot level repair of the subsystem:

(1) How important do you consider the forecasting of repair demand to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(2) Briefly describe the procedure used to generate the repair demand forecast.

(3) Was a formal model used?

(4) What was the model?

(5) How important do you consider it to be to have an in-house capability to generate a repair demand forecast for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(6) Briefly describe who was involved with forecasting repair demand.

(7) How important do you consider estimating the capacity of the resources programmed to meet the demands generated by repair requirements for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(8) What factors were considered when estimating the capacity of repair resources?

(9) How important do you consider it to be to have an in-house capability to estimate repair resource capacity for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(10) Briefly describe who was involved when estimating repair resource capacity.

(11) How important do you consider the division of repair and production resources to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(12) Why do you feel this way?

(13) What was the division of repair and production resources?

(14) How important do you consider the disposition of contractor repair resources to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(15) What was the plan for the disposition of contractor repair resources?

(16) What other factors do you consider to be of at least significant importance relative to repair capacity planning for this period?

(17) How well did the repair capacity planning process work?

(18) Were there any problems?

(19) What other comments or recommendations do you have regarding repair capacity planning or repair management?

INTERVIEW GUIDE C

During the period when it was planned to have organic depot level support equipment provide all depot level repair of the subsystem:

(1) How important do you consider forecasting of repair demand to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(2) Briefly describe the procedure used to generate the repair demand forecast.

(3) Was a formal model used?

(4) What was the model?

(5) How important do you consider it to be to have an in-house capability to generate a repair demand forecast for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(6) Briefly describe who was involved with forecasting repair demand.

(7) How important do you consider estimating the capacity of the resources programmed to meet the demands generated by repair requirements for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(8) What factors were considered when estimating the capacity of repair resources?

(9) How important do you consider it to be to have an in-house capability to estimate repair resource capacity for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(10) Briefly describe who was involved when estimating repair resource capacity.

(11) How important do you consider the division of repair and production resources to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(12) Why do you feel this way?

(13) What was the division of repair and production resources?

(14) How important do you consider the disposition of contractor repair resources to be relative to repair capacity planning for this period?

no opinion

no importance

little importance

acceptable amount

significant importance

great importance

(15) What was the plan for the disposition of contractor repair resources?

(16) What other factors do you consider to be of at least significant importance relative to repair capacity planning for this period?

(17) How well did the repair capacity planning process work?

(18) Were there any problems?

(19) What other comments or recommendations do you have regarding repair capacity planning or repair management?

APPENDIX B

SUBHYPOTHESIS FINDINGS

TABLE B.1

Subhypothesis 1A SPO Responses

Factors	Ordinal Responses								
	F-16			F-15			A-10		
	E	M	H	E	M	H	E	M	H
Demand forecasting	5	5	4	4	5	3	5	5	4
In-house forecasting	5	5	5	4	4	4	5	5	4
Estimating capacity	5	5	4	4	4	2	4	4	5
In-house estimating	5	5	4	4	4	1	4	5	4
Division	1	4	4	1	2	2	2	4	5
Disposition	4	5	3	2	2	1	4	4	3

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.2

Subhypothesis 1A Test Results

Factors	% of Ordinal Responses Greater Than or Equal To Significant Importance
Demand forecasting	88.9
In-house forecasting	100.0
Estimating capacity	88.9
In-house estimating	88.9
Division	44.4
Disposition	44.4

TABLE B.3

Subhypothesis 1B SPO Responses

Factors	F-16 E	F-16 M	F-16 H	F-15 E	F-15 M	F-15 H	A-10 E	A-10 M	A-10 H
Demand forecasting	3	4	4	4	3	4	4	5	4
In-house forecasting	4	4	4	5	4	4	4	5	5
Estimating capacity	4	5	5	4	4	4	3	4	5
In-house estimating	4	5	5	4	4	2	4	5	5
Division	5	5	5	4	2	2	4	4	5
Disposition	5	3	3	3	2	3	4	5	5

Ordinal Responses

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.4

Subhypothesis 1B Test Results

Factors	% of Ordinal Responses Greater Than or Equal To Significant Importance
Demand forecasting	77.8
In-house forecasting	100.0
Estimating capacity	88.9
In-house estimating	88.9
Division	77.8
Disposition	44.4

TABLE B.5

Subhypothesis 1C SPO Responses

Factors	F-16 E	F-16 M	F-16 H	F-15 E	F-15 M	F-15 H	A-10 E	A-10 M	A-10 H
Demand forecasting	5	5	5	2	4	4	4	4	3
In-house forecasting	5	5	5	5	4	5	5	4	4
Estimating capacity	5	5	5	4	4	5	5	4	5
In-house estimating	5	5	5	4	4	4	5	4	4
Division	2	3	3	1	2	1	2	2	3
Disposition	5	2	2	3	2	2	4	4	4

(Ordinal Responses)

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.6

Subhypothesis 1C Test Results

Factors	% of Ordinal Responses Greater Than or Equal To Significant Importance
Demand forecasting	77.8
In-house forecasting	100.0
Estimating capacity	100.0
In-house estimating	100.0
Division	00.0
Disposition	44.4

TABLE B.7

Subhypothesis 2A Contractor Responses

Factors	Ordinal Responses								
	F-16			F-15			A-10		
	E	M	H	E	M	H	E	M	H
Demand forecasting	5	5	5	5	4	5	4	4	3
In-house forecasting	5	4	5	4	4	4	5	5	4
Estimating capacity	5	5	5	5	5	5	5	5	5
In-house estimating	5	5	5	4	4	4	5	5	5
Division	4	5	4	5	5	5	5	5	3
Disposition	2	4	2	5	5	5	3	3	2

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.8

Subhypothesis 2A Test Results

Factors	% of Ordinal Responses Greater Than or Equal To Significant Importance
Demand forecasting	88 9
In-house forecasting	100.0
Estimating capacity	100.0
In-house estimating	100.0
Division	88 9
Disposition	44.4

TABLE B.9

Subhypothesis 2B Contractor Responses

Factors	Ordinal Responses F-16 E	M	H	F-15 E	M	H	A-10 E	M	H
Demand forecasting	5	4	5	5	5	5	4	4	4
In-house forecasting	5	4	5	4	4	4	4	4	4
Estimating capacity	5	5	5	5	5	5	3	3	4
In-house estimating	5	5	5	4	4	4	5	5	4
Division	4	5	4	5	5	5	5	5	3
Disposition	4	4	4	5	5	5	3	3	4

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.10

Subhypothesis 2B Test Results

Factors	% of Ordinal Responses Greater Than or Equal To Significant Importance
Demand forecasting	100.0
In-house forecasting	100.0
Estimating capacity	77.8
In-house estimating	100.0
Division	88.9
Disposition	77.8

TABLE B.11

Subhypothesis 2C Contractor Responses

Factors	F-16 E	F-16 M	F-16 H	F-15 E	F-15 M	F-15 H	A-10 E	A-10 M	A-10 H
Demand forecasting	5	3	5	5	5	5	3	3	5
In-house forecasting	5	3	5	4	4	4	1	1	4
Estimating capacity	5	5	5	5	5	5	4	4	2
In-house estimating	5	5	5	4	4	4	2	2	3
Division	4	3	4	1	1	1	3	3	3
Disposition	5	4	5	1	1	1	3	3	5

(Column header "Ordinal Responses" spans all F-16, F-15, A-10 columns.)

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.12

Subhypothesis 2C Test Results

Factors	% of Ordinal Responses Greater Than or Equal To Significant Importance
Demand forecasting	66.7
In-house forecasting	66.7
Estimating capacity	88.9
In-house estimating	66.7
Division	22.2
Disposition	44.4

TABLE B.13

Subhypothesis 5A Responses

Planning Element	Factors	F-16 E	F-16 M	F-16 H	F-15 E	F-15 M	F-15 H	A-10 E	A-10 M	A-10 H
SPO	Demand forecasting	5	5	4	4	5	3	5	5	4
	In-house forecasting	5	5	5	4	4	4	5	5	4
	Estimating capacity	5	5	4	4	4	2	4	4	5
	In-house estimating	5	5	4	4	4	1	4	5	4
	Division	1	4	4	1	2	2	2	4	5
	Disposition	4	5	3	2	2	1	4	4	3
Contractor	Demand forecasting	5	5	5	5	4	5	4	4	3
	In-house forecasting	5	4	5	4	4	4	5	5	4
	Estimating capacity	5	5	5	5	5	5	5	5	5
	In-house estimating	5	5	5	4	4	4	5	5	5
	Division	4	5	4	5	5	5	5	5	3
	Disposition	2	4	2	5	5	5	3	3	2

(Ordinal Responses)

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.14

Subhypothesis 5A Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	85.5	0.10	CR
In-house forecasting	90.0	0.10	CR
Estimating capacity	58.5	0.10	R
In-house estimating	70.5	0.10	CR
Division	57.0	0.10	R
Disposition	80.0	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

R denotes reject Null hypothesis

TABLE B.15

Subhypothesis 5B Responses

Planning Element	Factors	F-16 E	F-16 M	F-16 H	F-15 E	F-15 M	F-15 H	A-10 E	A-10 M	A-10 H
SPO	Demand forecasting	5	5	4	4	5	3	5	5	4
	In-house forecasting	5	5	5	4	4	4	5	5	4
	Estimating capacity	5	5	4	4	4	2	4	4	5
	In-house estimating	5	5	4	4	4	1	4	5	4
	Division	1	4	4	1	2	2	2	4	5
	Disposition	4	5	3	2	2	1	4	4	3
Contractor	Demand forecasting	5	4	5	5	5	5	4	4	4
	In-house forecasting	5	4	5	4	4	4	4	4	4
	Estimating capacity	5	5	5	5	5	5	3	3	4
	In-house estimating	5	5	5	4	4	4	5	5	4
	Division	4	5	4	5	5	5	5	5	3
	Disposition	4	4	4	5	5	5	3	3	4

Ordinal Responses (columns F-16, F-15, A-10)

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.16

Subhypothesis 5B Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	93.5	0.10	CR
In-house forecasting	99.0	0.10	CR
Estimating capacity	75.5	0.10	CR
In-house estimating	74.5	0.10	CR
Division	55.5	0.10	R
Disposition	66.5	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

R denotes reject Null hypothesis

TABLE B.17

Subhypothesis 5C Responses

Planning Element	Factors	F-16 E	F-16 M	F-16 H	F-15 E	F-15 M	F-15 H	A-10 E	A-10 M	A-10 H
		Ordinal Responses								
SPO	Demand forecasting	3	4	4	4	3	4	4	5	4
	In-house forecasting	4	4	4	5	4	4	4	5	5
	Estimating capacity	4	5	5	4	4	4	3	4	5
	In-house estimating	4	5	5	4	4	2	4	5	5
	Division	5	5	5	4	2	2	4	4	5
	Disposition	5	3	3	3	2	3	4	5	5
Contractor	Demand forecasting	5	3	5	5	5	5	3	3	5
	In-house forecasting	5	3	5	4	4	4	1	1	4
	Estimating capacity	5	5	5	5	5	5	4	4	2
	In-house estimating	5	5	5	4	4	4	2	2	3
	Division	4	3	4	1	1	1	3	3	3
	Disposition	5	4	5	1	1	1	3	3	5

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.18

Subhypothesis 5C Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	72.0	0.10	CR
In-house forecasting	99.0	0.10	CR
Estimating capacity	74.0	0.10	CR
In-house estimating	94.0	0.10	CR
Division	111.0	0.10	R
Disposition	92.0	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

R denotes reject Null hypothesis

TABLE B.19

Subhypothesis 6A SPO Responses

		Ordinal Responses								
		F-16			F-15			A-10		
Period	Factors	E	M	H	E	M	H	E	M	H
Contractor	Demand forecasting	5	5	4	4	5	3	5	5	4
	In-house forecasting	5	5	5	4	4	4	5	5	4
	Estimating capacity	5	5	4	4	4	2	4	4	5
	In-house estimating	5	5	4	4	4	1	4	5	4
	Division	1	4	4	1	2	2	2	4	5
	Disposition	4	5	3	2	2	1	4	4	3
Contractor	Demand forecasting	3	4	4	4	3	4	4	5	4
&	In-house forecasting	4	4	4	5	4	4	4	5	5
Organic	Estimating capacity	4	5	5	4	4	4	3	4	5
	In-house estimating	4	5	5	4	4	2	4	5	5
	Division	5	5	5	4	2	2	4	4	5
	Disposition	5	3	3	3	2	3	4	5	5

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.20

Subhypothesis 6A Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	98.5	0.10	CR
In-house forecasting	94.5	0.10	CR
Estimating capacity	85.0	0.10	CR
In-house estimating	81.0	0.10	CR
Division	65.5	0.10	R
Disposition	76.0	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis
R denotes reject Null hypothesis

TABLE B.21

Subhypothesis 6B SPO Responses

		Ordinal Responses								
		F-16			F-15			A-10		
Period	Factors	E	M	H	E	M	H	E	M	H
Contractor	Demand forecasting	5	5	4	4	5	3	5	5	4
	In-house forecasting	5	5	5	4	4	4	5	5	4
	Estimating capacity	5	5	4	4	4	2	4	4	5
	In-house estimating	5	5	4	4	4	1	4	5	4
	Division	1	4	4	1	2	2	2	4	5
	Disposition	4	5	3	2	2	1	4	4	3
Organic	Demand forecasting	5	5	5	2	4	4	4	4	3
	In-house forecasting	5	5	5	5	4	5	5	4	4
	Estimating capacity	5	5	5	4	4	5	5	4	5
	In-house estimating	5	5	5	4	4	4	5	4	4
	Division	2	3	3	1	2	1	2	2	3
	Disposition	5	2	2	3	2	2	4	4	4

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.22

Subhypothesis 6B Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	96.0	0.10	CR
In-house forecasting	81.0	0.10	CR
Estimating capacity	70.5	0.10	CR
In-house estimating	78.5	0.10	CR
Division	95.0	0.10	CR
Disposition	86.0	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

TABLE B.23

Subhypothesis 6C SPO Responses

		Ordinal Responses								
		F-16			F-15			A-10		
Period	Factors	E	M	H	E	M	H	E	M	H
Contractor & Organic	Demand forecasting	3	4	4	4	3	4	4	5	4
	In-house forecasting	4	4	4	5	4	4	4	5	5
	Estimating capacity	4	5	5	4	4	4	3	4	5
	In-house estimating	4	5	5	4	4	2	4	5	5
	Division	5	5	5	4	2	2	4	4	5
	Disposition	5	3	3	3	2	3	4	5	5
Organic	Demand forecasting	5	5	5	2	4	4	4	4	3
	In-house forecasting	5	5	5	5	4	5	5	4	4
	Estimating capacity	5	5	5	4	4	5	5	4	5
	In-house estimating	5	5	5	4	4	4	5	4	4
	Division	2	3	3	1	2	1	2	2	3
	Disposition	5	2	2	3	2	2	4	4	4

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.24

Subhypothesis 6C Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	79.5	0.10	CR
In-house forecasting	72.0	0.10	CR
Estimating capacity	70.5	0.10	CR
In-house estimating	83.0	0.10	CR
Division	116.0	0.10	R
Disposition	97.0	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

R denotes reject Null hypothesis

TABLE B.25

Subhypothesis 7A Contractor Responses

		Ordinal Responses								
		F-16			F-15			A-10		
Period	Factors	E	M	H	E	M	H	E	M	H
Contractor	Demand forecasting	5	5	5	5	4	5	4	4	3
	In-house forecasting	5	4	5	4	4	4	5	5	4
	Estimating capacity	5	5	5	5	5	5	5	5	5
	In-house estimating	5	5	5	4	4	4	5	5	5
	Division	4	5	4	5	5	5	5	5	3
	Disposition	2	4	2	5	5	5	3	3	2
Contractor	Demand forecasting	5	4	5	5	5	5	4	4	4
&	In-house forecasting	5	4	5	4	4	4	4	4	4
Organic	Estimating capacity	5	5	5	5	5	5	3	3	4
	In-house estimating	5	5	5	4	4	4	5	5	4
	Division	4	5	4	5	5	5	5	5	3
	Disposition	4	4	4	5	5	5	3	3	4

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.26

Subhypothesis 7A Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	83.5	0.10	CR
In-house forecasting	94.5	0.10	CR
Estimating capacity	99.0	0.10	CR
In-house estimating	90.0	0.10	CR
Division	85.5	0.10	CR
Disposition	73.5	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

TABLE B.27

Subhypothesis 7B Contractor Responses

		Ordinal Responses								
		F-16			F-15			A-10		
Period	Factors	E	M	H	E	M	H	E	M	H
Contractor	Demand forecasting	5	5	5	5	4	5	4	4	3
	In-house forecasting	5	4	5	4	4	4	5	5	4
	Estimating capacity	5	5	5	5	5	5	5	5	5
	In-house estimating	5	5	5	4	4	4	5	5	5
	Division	4	5	4	5	5	5	5	5	3
	Disposition	2	4	2	5	5	5	3	3	2
Organic	Demand forecasting	5	3	5	5	5	5	3	3	5
	In-house forecasting	5	3	5	4	4	4	1	1	4
	Estimating capacity	5	5	5	5	5	5	4	4	2
	In-house estimating	5	5	5	4	4	4	2	2	3
	Division	4	3	4	1	1	1	3	3	3
	Disposition	5	4	5	1	1	1	3	3	5

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.28

Subhypothesis 7B Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	85.5	0.10	CR
In-house forecasting	102.0	0.10	CR
Estimating capacity	99.0	0.10	CR
In-house estimating	103.5	0.10	CR
Division	120.0	0.10	R
Disposition	90.0	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis

R denotes reject Null hypothesis

TABLE B.29

Subhypothesis 7C Contractor Responses

		Ordinal Responses								
		F-16			F-15			A-10		
Period	Factors	E	M	H	E	M	H	E	M	H
Contractor & Organic	Demand forecasting	5	4	5	5	5	5	4	4	4
	In-house forecasting	5	4	5	4	4	4	4	4	4
	Estimating capacity	5	5	5	5	5	5	3	3	4
	In-house estimating	5	5	5	4	4	4	5	5	4
	Division	4	5	4	5	5	5	5	5	3
	Disposition	4	4	4	5	5	5	3	3	4
Organic	Demand forecasting	5	3	5	5	5	5	3	3	5
	In-house forecasting	5	3	5	4	4	4	1	1	4
	Estimating capacity	5	5	5	5	5	5	4	4	2
	In-house estimating	5	5	5	4	4	4	2	2	3
	Division	4	3	4	1	1	1	3	3	3
	Disposition	5	4	5	1	1	1	3	3	5

NOTE: E denotes electrical subsystem

M denotes mechanical subsystem

H denotes hydraulic subsystem

TABLE B.30

Subhypothesis 7C Test Results

Factors	T	Alpha Level	Null Hypothesis
Demand forecasting	87.0	0.10	CR
In-house forecasting	96.0	0.10	CR
Estimating capacity	85.0	0.10	CR
In-house estimating	100.5	0.10	CR
Division	120.0	0.10	R
Disposition	97.5	0.10	CR

NOTE: CR denotes cannot reject Null hypothesis
R denotes reject Null hypothesis

APPENDIX C

SUMMARY FINDINGS

TABLE C.1

Subhypotheses 1A, 1B, and 1C

Test Results

Factors	Subhypothesis Test Results 1A	1B	1C
Demand forecasting	S	S	S
In-house forecasting	S	S	S
Estimating capacity	S	S	S
In-house estimating	S	S	S
Division	R	S	R
Disposition	R	R	R

NOTE: S denotes the subhypothesis was supported

R denotes the subhypothesis was rejected

TABLE C.2

Subhypotheses 2A, 2B, and 2C

Test Results

Factors	Subhypothesis Test Results 2A	2B	2C
Demand forecasting	S	S	R
In-house forecasting	S	S	R
Estimating capacity	S	S	S
In-house estimating	S	S	R
Division	S	S	R
Disposition	R	S	R

NOTE: S denotes the subhypothesis was supported

R denotes the subhypothesis was rejected

TABLE C.3

Subhypotheses 5A, 5B, and 5C

Test Results

Factors	Subhypothesis Test Results 5A	5B	5C
Demand forecasting	R	R	R
In-house forecasting	R	R	R
Estimating capacity	S	R	R
In-house estimating	R	R	R
Division	S	S	S
Disposition	R	R	R

NOTE: S denotes the subhypothesis was supported

R denotes the subhypothesis was rejected

TABLE C.4

Subhypotheses 6A, 6B, and 6C

Test Results

Factors	6A	6B	6C
	Subhypothesis Test Results		
Demand forecasting	R	R	R
In-house forecasting	R	R	R
Estimating capacity	R	R	R
In-house estimating	R	R	R
Division	S	R	S
Disposition	R	R	R

NOTE: S denotes the subhypothesis was supported

R denotes the subhypothesis was rejected

TABLE C.5

Subhypotheses 7A, 7B, and 7C

Test Results

Factors	Subhypothesis Test Results 7A	7B	7C
Demand forecasting	R	R	R
In-house forecasting	R	R	R
Estimating capacity	R	R	R
In-house estimating	R	R	R
Division	R	S	S
Disposition	R	R	R

NOTE: S denotes the subhypothesis was supported

R denotes the subhypothesis was rejected

GLOSSARY

-A-

acquisition - The process consisting of planning, designing, producing, and distributing a weapon system/equipment. Acquisition in this sense includes the conceptual, validation, full scale development, production, and deployment/operational phases of the weapon system/equipments project [11:11].

AD - Armament Division of AFSC

AFLC - Air Force Logistics Command

AFP - Air Force Pamphlet

AFSC - Air Force Systems Command

ALC - Air Logistics Center

ASD - Aeronautical Systems Division of AFSC

-B-

BMO - Ballistic Missile Office of AFSC

-C-

component - An assembly or any combination of parts, subassemblies and assemblies mounted together, normally capable of independent operation in a variety of situations. An integral constituent of a complete (end) item. A component may consist of a part, assembly or subassembly [11:144].

-D-

DCP - Decision Coordinating Paper

depot level maintenance - The maintenance, repair, or modification of an end item or equipment requiring major overhaul or complete rebuilding of certain parts, and usually provided for only at an AF depot or contractor overhaul facility. The more extensive shop equipment that enters into depot level maintenance distinguishes it from organizational level maintenance [11:215].

DoD - Department of Defense

DSARC - Defense Systems Acquisition Review Council

-E-

end item - A final combination of end products, component parts, and/or materials which is ready for its intended use, e.g. aircraft, ships, tanks, mobile machine shop [11:254].

ESD - Electronic Systems Division of AFSC

-F-

FSD - Full Scale Development

-G-

GFE - Government Furnished Equipment

-I-

ILS - Integrated Logistic Support - A composite of the elements necessary to assure the effective and economical support of a system or equipment at all levels of maintenance for its programmed life cycle. It is

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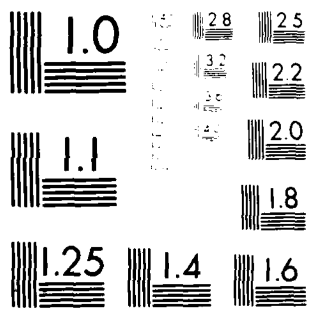

MICROCOPY RESOLUTION TEST CHART

characterized by the harmony and coherence obtained between each of its elements and levels of maintenance [11:356].

IM - Item Manager

IPS - Integrated Program Summary

integration and test - The process of accomplishing overall scheduling, assembly, and system checkout of associate contractor and/or subcontractor activities and equipment, and furnishing specified support services which are common to several of the contractors, under Air Force direction; such direction, in some cases, being channeled through the contractor performing the function of systems engineering. In some cases, the contractor responsible for performing the functions of integration, assembly, and checkout also may produce portions of a system [11:358].

I level maintenance - intermediate level maintenance - Maintenance that is normally the responsibility of, and performed by, designated maintenance activities for direct support of using organizations. Its phases normally consist of calibrating, repairing, or replacing damaged or unserviceable parts, components or assemblies; modification of materiel, emergency manufacturing of unavailable parts; and providing technical assistance to using organizations. Intermediate maintenance is normally accomplished by the using commands in fixed or mobile shops [11:361].

-J-

JMSNS - Justification for Major System New Start

-L-

lead time - The allowance made for the amount of time required to accomplish a specific objective [11:385].

depot level maintenance - The maintenance, repair, or modification of an end item or equipment requiring major overhaul or complete rebuilding of certain parts, and usually provided for only at an AF depot or contractor overhaul facility. The more extensive shop equipment that enters into depot level maintenance distinguishes it from organizational level maintenance [11:215].

DoD - Department of Defense

DSARC - Defense Systems Acquisition Review Council

-E-

end item - A final combination of end products, component parts, and/or materials which is ready for its intended use, e.g. aircraft, ships, tanks, mobile machine shop [11:254].

ESD - Electronic Systems Division of AFSC

-F-

FSD - Full Scale Development

-G-

GFE - Government Furnished Equipment

-I-

ILS - Integrated Logistic Support - A composite of the elements necessary to assure the effective and economical support of a system or equipment at all levels of maintenance for its programmed life cycle. It is

life cycle - The total life span of an end item commencing with the concept formulation phase and extending through the operational phase up to its removal from the DoD inventory and ultimate disposal [11:390].

logistic support - Those aspects of military operations which deal with the design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposition of materiel [11:399-400].

LRU - Line Replaceable Unit - An item that is normally removed and replaced as a single unit to correct a deficiency or malfunction on a weapon system or support system and item of equipment. Any assembly which can be removed as a unit from the system at the operating location [11:393].

-M-

maintainability - A characteristic of design and installation expressed as the probability that an item will be restored to a specified condition within a given period of time when the maintenance is performed using prescribed procedures and resources [11:406].

maintenance concept - A description of the planned general scheme for maintenance and support of an item in the operational environment [11:409].

maintenance plan - A description of the requirements and tasks to be accomplished for achieving, restoring, or maintaining the operational capability of a system, equipment, or facility [11:414].

MTBF - Mean Time Between Failures - The mean operating time between failures during which the item performs as specified [11:439].

MTTR - Mean Time To Repair - The statistical mean of the distribution of times-to-repair. The summation of active repair times during a given period of time divided by the total number of malfunctions during the same time interval [11:440].

-O-

OJCS - Office of the Joint Chiefs of Staff

OMB - Office of Management and Budget

organic - Assigned to and forming an essential part of a military organization [11:499].

O level maintenance - organizational level maintenance - That maintenance which a using organization performs on its own equipment with the use of its own skills [11:500].

OSD - Office of the Secretary of Defense

-P-

PDM - Program Decision Memorandum

PMRT - Program Management Responsibility Transfer

POM- Program Objectives Memorandum

PPBS - Planning/Programming/Budgeting System

-R-

repair - The restoration or replacement of parts or components of real property or equipment as necessitated by wear and tear, damage, failure of parts or the like, in order to maintain it in efficient operating condition [11:578].

reparable - An unserviceable item that can be repaired and restored to a serviceable condition [11:581].

-S-

SCP - System Concept Paper

SDDM - Secretary of Defense Decision Memorandum

SM - System Manager

special test equipment - Electrical, electronic, hydraulic, pneumatic, mechanical or other items or assemblies of equipment, which are of such a specialized nature that, without modification or alteration, the use of such items (if they are to be used separately) or assemblies is limited to testing in the development or production of particular supplies or parts thereof, or in the performance of particular services [11:642].

SPO - System Program Office

SRA - Special Repair Activity

SRU - Shop Replaceable Unit - A module for an LRU which can be removed from the LRU at an intermediate repair facility [11:627].

subcontractor - Any supplier, distributor, vendor, or firm which furnishes supplies or services to or from a prime contractor or another subcontractor [11:664].

supplier - The supplier is the individual or concern actually performing services or manufacturing, producing, and shipping any supplies required by the contract or subcontract concerned. The supplier may be a contractor or subcontractor [11:667].

support equipment - Support equipment consists of nonexpendable tools, test equipment, automatic test equipment, industrial, and communications-electronics-meteorological equipment [11:672].

-U-

USAF - United States Air Force

-W-

weapon system - Is defined as an instrument of combat either offensive or defensive used to destroy, injure, defeat or threaten the enemy. It consists of a total entity of an instrument of combat, i.e., F-104 aircraft, F-106 aircraft, submarines, destroyers, M60 tank, Hawk missile [11:741].

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